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# INTRODUCTION

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*Volume 9 Number 20 / October 23, 1971*

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**02 AIRCRAFT**
Includes fixed-wing airplanes, helicopters, gliders, balloons, ornithopters, etc; and specific types of complete aircraft (e.g., ground effect machines, STOL, and VTOL); flight tests; operating problems (e.g., sonic boom); safety and safety devices; economics; and stability and control. For basic research see: 01 Aerodynamics. For related information see also: 31 Space Vehicles; and 32 Structural Mechanics. **3208**

**03 AUXILIARY SYSTEMS**
Includes fuel cells, energy conversion cells, and solar cells; auxiliary gas turbines; hydraulic, pneumatic and electrical systems; actuators; and inverters. For related information see also: 09 Electronic Equipment; 22 Nuclear Engineering; and 28 Propulsion Systems. **3213**

**04 BIOSCIENCES**
Includes aerospace medicine, exobiology, radiation effects on biological systems; physiological and psychological factors. For related information see also: 05 Biotechnology. **3215**

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Includes chemical analysis and identification (e.g., spectroscopy). For applications see: 17 Materials, Metallic; 18 Materials, Nonmetallic; and 27 Propellants. **3228**

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Includes communications equipment and techniques; noise; radio and communications blackout; modulation telemetry; tracking radar and optical observation; and wave propagation. For basic research see: 23 Physics, General; and 21 Navigation. **3231**

**08 COMPUTERS**
Includes computer operation and programming; and data processing. For applications, see specific categories. For related information see also: 19 Mathematics. **3237**

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Includes electronic test equipment and maintainability; component parts, e.g., electron tubes, tunnel diodes, transistors; integrated circuitry; microminiaturization. For basic research see: 10 Electronics. For related information see also: 07 Communications and 21 Navigation. 3239

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Includes circuit theory; and feedback and control theory. For applications see: 09 Electronic Equipment. For related information see specific Physics categories. 3242

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Includes airports; lunar and planetary bases including associated vehicles; ground support systems; related logistics; simulators; test facilities (e.g., rocket engine test stands, shock tubes, and wind tunnels); test ranges; and tracking stations. 3244

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Includes boundary-layer flow; compressible flow; gas dynamics; hydrodynamics; and turbulence. For related information see also: 01 Aerodynamics; and 33 Thermodynamics and Combustion. 3248

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Includes structural element design and weight analysis; fatigue; thermal stress; impact phenomena; vibration; flutter; inflatable structures; and structural tests. For related information see also: 17 Materials, Metallic; and 18 Materials, Nonmetallic. **3356**

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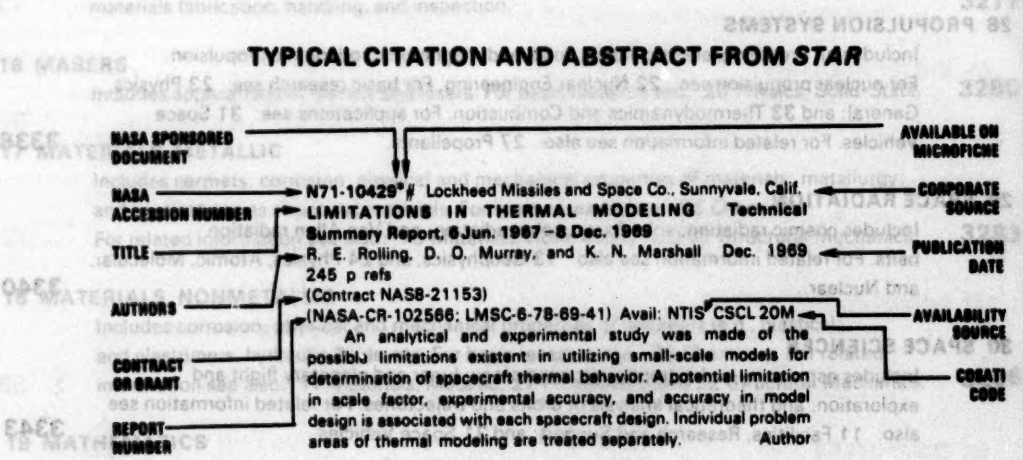
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An analytical and experimental study was made of the possible limitations existent in utilizing small-scale models for determination of spacecraft thermal behavior. A potential limitation in scale factor, experimental accuracy, and accuracy in model design is associated with each spacecraft design. Individual problem areas of thermal modeling are treated separately. Author

VOLUME 9 NUMBER 20 / OCTOBER 23, 1971

# Scientific and Technical Aerospace Reports

*A Semimonthly Publication of the National Aeronautics and Space Administration*

## 01 AERODYNAMICS

Includes aerodynamics of bodies, combinations, internal flow in ducts and turbo machinery; wings, rotors, and control surfaces. For applications see: 02 Aircraft and 31 Space Vehicles. For related information see also: 12 Fluid Mechanics; and 33 Thermodynamics and Combustion.

**N71-32801*#** Bellcomm, Inc., Washington, D.C.
**SUPERSONIC FLOW OVER CONVEX AND CONCAVE SHAPES WITH RADIATION AND ABLATION EFFECTS**
I. O. Bohachevsky and R. N. Kostoff 2 Aug. 1971 79 p refs
(Contract NASw-417)
(NASA-CR-121371; TM-71-1013-5) Avail: NTIS CSCL 01A

A first-order accurate numerical method of unsteady adjustment is employed to calculate inviscid flowfields about convex and concave shapes. Two geometries are used: conical forebodies with spherical afterbodies whose cone half-angles range from 50 to 135 deg and thin-walled cylinders with cylindrical cavities of different depth facing the oncoming stream. Computations with radiative heat transfer effects are carried out for two cases, namely, flow over a 50 and an 80 deg half-angle cone. A grey gas model is assumed; unlike previous studies, no restriction is placed on the gas optical thickness nor is a slab approximation made. Results show a significant departure from the slab approximation near surface discontinuities and large radiative energy losses near cold surfaces. For a 50 deg half-angle cone, a calculation is performed with massive gas injection at the cone surface. Results show that the bow shock detaches from the surface and the shock layer divides into an inner layer containing the injected gas and an outer layer without injectant. Author

**N71-32805*#** National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
**WIND-TUNNEL INVESTIGATION OF A LARGE 35 DEGREE SWEPT-WING JET TRANSPORT MODEL WITH AN EXTERNAL-FLOWJET-AUGMENTED DOUBLE-SLOTTED FLAP**
Kiyoshi Aoyagi and Leo P. Hall Washington Aug. 1971 73 p refs
(NASA-TN-D-6482; A-3523) Avail: NTIS CSCL 01A

The model had a low-mounted wing of aspect ratio 7.82 and four pod-mounted jet engines under the wing. The lift of the flap system was augmented by impingement of the exhaust of the jet engines on the main flap and a small auxiliary flap. The auxiliary flap may be used for direct-lift control. Results were obtained for several main and auxiliary flap deflections at gross thrust coefficients of 0 to 2.0. Three-component longitudinal data are presented with the operation of four and two engines. Limited longitudinal and lateral data are presented for the operation of three engines. Author

**N71-32814#** Midwest Research Inst., Kansas City, Mo.
**ESTIMATION OF FORCES ON A FLECHETTE RESULTING FROM A SHOCK WAVE Final Report, 19 Jun. 1970 - 18 Mar. 1971**
William D. Glauz 18 May 1971 62 p refs
(Contract DAAA25-70-C-0655)
(AD-724178) Avail: NTIS CSCL 19/1

The potential deflecting forces on a flechette arising from a shock wave are investigated. The predominate force acts on the fins and is caused by the cross flow induced by the oblique shock wave. Also important are the cross flow over the nose and the local pressure unbalance near the shock wave. The forces and moments are determined to be of sufficient magnitude to cause appreciable scatter, but exterior ballistic calculations are needed to quantify the scatter. Several refinements to the force calculations are suggested. Author (GRA)

**N71-32862#** Royal Aircraft Establishment, Farnborough (England). Aerodynamics Dept.
**A SCHEME OF NOTATION AND NOMENCLATURE FOR AIRCRAFT DYNAMICS AND ASSOCIATED AERODYNAMICS. PART 2: BASIC NOTATION AND NOMENCLATURE**
H. R. Hopkin London Aeron. Res. Council 1970 52 p Supersedes RAE-TR-66200-Pt-2; N68-13059; ARC-28970
(ARC-R/M-3562-Pt-2; RAE-TR-66200; ARC-28970) Copyright. Avail: NTIS; HMSO: £1.10; BIS: $4.05

A scheme of notation and nomenclature applicable to the dynamics and associated aerodynamics of both aircraft and missiles is proposed. The proposals are intended to supersede prior attempts to revise and extend the existing standard reference in this field. Basic notation and nomenclature, aircraft dynamics, and associated aerodynamic data respectively are dealt with. Author (ESRO)

**N71-32868#** National Physical Lab., Teddington (England). Aerodynamics Div.
**PRESSURES NEAR THE CENTRE-LINE OF LEEWARD SURFACES ON DELTA WINGS AND CONICAL BODIES AT HIGH SUPERSONIC SPEEDS**
M. J. Lercombe London Aeron. Res. Council 1971 26 p refs Supersedes NPL-AERO-1319; ARC-32172
(ARC-CP-1153; NPL-AERO-1319; ARC-32172) Copyright. Avail: NTIS; HMSO: 40p; BIS: $1.60

The manner in which the flow fields over the leeward surfaces of delta wings and conical bodies can be calculated for conditions when the bow shock wave is detached from the leading edges is dealt with. The significant features and the parameters controlling the flow process are determined. As a first step towards the calculation of the complete flow field on leeward surfaces an accurate semiempirical method is developed for predicting pressures near the center-line of wings and bodies for Mach numbers greater than 2.5. Author (ESRO)

**N71-32875#** Royal Aircraft Establishment, Farnborough (England). Aerodynamics Dept.

**A SCHEME OF NOTATION AND NOMENCLATURE FOR AIRCRAFT DYNAMICS AND ASSOCIATED AERODYNAMICS. PART 3: AIRCRAFT DYNAMICS**

H. R. Hopkin London Aeron. Res. Council 1970 62 p Supersedes RAE-TR-66200-Pt-3; N68-13058; ARC-28971

(ARC-R/M-3562-Pt-3; RAE-TR-66200-Pt-3; ARC-28971) Copyright. Avail: NTIS; HMSO: £1.65; BIS: $6.30

A scheme of notation and nomenclature applicable to the dynamics and associated aerodynamics of both aircraft and missiles is proposed. The proposals are intended to supersede prior attempts to revise and extend the existing standard reference in this field. Basic notation and nomenclature, aircraft dynamics, and associated aerodynamics data respectively, are dealt with. Author (ESRO)

**N71-32934#** Oceanics, Inc., Plainview, N.Y.

**TEST SECTION SIZE INFLUENCE ON MODEL HELICOPTER ROTOR PERFORMANCE Final Technical Report**

August F. Lehman and Jeffrey A. Besold Mar. 1971 74 p refs

(Contract DAAJ02-68-C-0108)

(AD-724191; Rept-70-76; USAAVLABS-TR-71-6) Avail: NTIS CSCL 14/2

The study indicates that the successful testing of model helicopter rotors in tunnels when in the hover and transitional flight regimes requires not only Reynolds number scaling, where the Reynolds number is recognized as controlling the rotors maximum section lift coefficient, but also a scaling of a characteristic defined here as the wake energy dissipation pattern. The dissipation of the energy from the rotor into the surrounding fluid is a function of the viscosity of the test fluid; thus, operation of a reduced scale model in the same fluid as that in which the full-scale vehicle operates makes appropriate scaling of this wake characteristic difficult if Reynolds number scaling is to be maintained. These conflicting factors have led to the requirements of relatively large models and correspondingly large transitional flight modes are of interest. The use of water as the test fluid for scale model studies permits an easier maintaining of Reynolds number scaling while having the scale model produce a wake energy dissipation pattern similar to that of the full-scale vehicle because of the advantages water possesses over air in terms of kinematic anf dynamic viscosities. Author (GRA)

**N71-32976#** Royal Aircraft Establishment, Farnborough (England). Aerodynamics Dept.

**A SCHEME OF NOTATION AND NOMENCLATURE FOR AIRCRAFT DYNAMICS AND ASSOCIATED AERODYNAMICS. PART 4: AERODYNAMIC DATA FOR DYNAMICS**

H. R. Hopkin London Aeron. Res. Council 1970 45 p Supersedes RAE-TR-66200-Pt-4; N68-13895; ARC-28972

(ARC-R/M-3562-Pt-4; RAE-TR-66200-Pt-4; ARC-28972) Copyright. Avail: NTIS; HMSO: £1.00; BIS: $3.60

A scheme of notation and nomenclature applicable to the dynamics and associated aerodynamics of both aircraft and missiles is proposed. The proposals are intended to supersede prior attempts to revise and extend the existing standard reference in this field. Basic notation and nomenclature, aircraft dynamics, and associated aerodynamic data respectively are dealt with. Author (ESRO)

**N71-33002*#** Nielsen Engineering and Research, Inc., Mountain View, Calif.

**COMPUTER PROGRAMS FOR CALCULATION OF AERODYNAMIC INTERFERENCE BETWEEN LIFTING SURFACES AND LIFT AND CRUISE FANS**

M. F. E. Dillenius, M. R. Mendenhall, and S. B. Spangler Apr. 1971 172 p refs

(Contract NAS2-5247)

(NASA-CR-114332; NEAR-TR-29) Avail: NTIS CSCL 01A

A user's manual is presented for a series of three computer programs developed to predict aerodynamic interference in transport-type aircraft. The cases considered are interference between a high-bypass ratio turbofan engine and a wing-pylon-tail configuration, and interference between a fuselage-mounted lift fan and a wing-tail configuration. The methods are applicable to all speeds up to the critical speed of the configuration. The first program calculates the singularity distributions representing the flow model of a high-bypass ratio turbofan engine and computes the velocity field induced by the singularities. The second program computes the singularity distributions representing the wake of a lift fan exhausting in a crossflow. The path of the jet is predicted and the velocity field induced by the jet is computed. The third program is a vortex lattice lifting surface method which can accommodate a wing with a single pylon per panel and a horizontal tail surface. This program can accept externally induced velocities such as those obtained from the turbofan engine program or the lift-fan program. Author

**N71-33027#** Royal Aircraft Establishment, Farnborough (England). Aerodynamics Dept.

**A SCHEME OF NOTATION AND NOMENCLATURE FOR AIRCRAFT DYNAMICS AND ASSOCIATED AERODYNAMICS. PART 1: GENERAL**

H. R. Hopkin London Aeron. Res. Council 1970 75 p refs Supersedes RAE-TR-66200-Pt-1; N68-13135; ARC-28969

(ARC-R/M-3562-Pt-1; RAE-TR-66200-Pt-1; ARC-28969) Copyright. Avail: NTIS; HMSO: £1.60; BIS: $5.85

A scheme of notation and nomenclature applicable to the dynamics and associated aerodynamics of both aircraft and missiles is proposed. The proposals are intended to supersede prior attempts to revise and extend the existing standard reference in this field. The main objectives are described and a considerable amount of historical background is summarized. Symbols, references, and most of the tables for the whole report are listed and an index is provided. All illustrations are appended. Author (ESRO)

**N71-33028#** Royal Aircraft Establishment, Farnborough (England). Aerodynamics Dept.

**A SCHEME OF NOTATION AND NOMENCLATURE FOR AIRCRAFT DYNAMICS AND ASSOCIATED AERODYNAMICS. PART 5: APPENDICES**

H. R. Hopkin London Aeron. Res. Council 1970 63 p Supersedes RAE-TR-66200-Pt-5; N68-13891; ARC-27973

(ARC-R/M-3562-Pt-5; RAE-TR-66200-Pt-5; ARC-27973) Copyright. Avail: NTIS; HMSO: £1.40; BIS: $5.40

A scheme of notation and nomenclature applicable to the dynamics and associated aerodynamics of both aircraft and missiles is proposed. The proposals are intended to supersede prior attempts to revise and extend the existing standard reference in this field. A great deal of reference information is included in the twelve appendices. Author (ESRO)

**N71-33038*+** National Aeronautics and Space Administration, Washington, D.C.

**AERONAUTICAL ENGINEERING: A SPECIAL BIBLIOGRAPHY WITH INDEXES. SUPPLEMENT 6, MAY 1971**

Jun. 1971 161 p refs

(NASA-SP-7037(06)) Avail: NTIS CSCL 01A

The bibliography lists 534 reports, articles, and other documents introduced into the NASA scientific and technical information system in May 1971. Emphasis is placed on engineering and theoretical aspects for design, construction, evaluation, testing, operation, and performance of aircraft (including aircraft engines) and associated components, equipment, and systems. Entries on research and development in aeronautics and aerodynamics, and research and ground support for aeronautical vehicles are also included. Author

**N71-33037#** Saab Aircraft Co., Linkoping (Sweden).
**AN EXACT METHOD OF TWO-DIMENSIONAL AIRFOIL DESIGN**
Bert Arlinger Oct. 1970 37 p refs
(SAAB-TN-67) Avail: NTIS

An inverse method of airfoil design has been developed for the calculation of an airfoil starting from a velocity distribution prescribed as a function of the distance along the airfoil surface. The method is based on conformal transformation of a profile onto a circle. In order to obtain a closed airfoil the prescribed velocity distribution must be corrected so that certain conditions are satisfied. This correction is made on a prescribed limited part of the airfoil contour, for instance along the lower side in order not to change a designed velocity distribution along the upper side. No approximations are made in the method, implying that only numerical inaccuracies may be present. It is programmed for running on a time-sharing computer system. To illustrate the calculation procedure and the capabilities of the method a few airfoils are designed. The efficiency of the method when designing an airfoil with prescribed lift, upper side velocity distribution, and maximum thickness is demonstrated. Author (ESRO)

**N71-33116#** Von Karman Inst. for Fluid Dynamics, Rhode Saint-Genese (Belgium).
**A FIRST ORDER THEORY FOR PREDICTING THE STABILITY OF CABLE TOWED AND TETHERED BODIES WHERE THE CABLE HAS A GENERAL CURVATURE AND TENSION VARIATION**
James D. Delaurier Dec. 1970 124 p refs
(VKI-TN-68) Avail: NTIS

The dynamics of cable-body systems are investigated and an analysis for finding the stability of towed and tethered bodies in a fluid stream is developed. The cable-body system is treated analytically by considering it to be essentially a cable problem, where the body provides end and auxiliary conditions. The mathematical description of the first order motion of a cable with a general shape and tension variation is a sequence of nonhomogeneous boundary value problems in linear partial differential wave equations, with linear ordinary differential end and auxiliary conditions. Further, the equations uncouple to five a "lateral" problem and a "longitudinal" problem, as in first order aircraft dynamics. The solution of either problem takes the form of a transcendental characteristic equation for the stability roots. These roots are extracted by using an electronic computer and a roots locus plot. In order to provide a check on the theoretical analysis, a series of tests were performed on a cable-body system tethered in the VKI open throat, low speed wind tunnel. Author (ESRO)

**N71-33140*#** Lockheed-Georgia Co., Marietta.
**MATHEMATICAL MODEL FOR TWO-DIMENSIONAL MULTICOMPONENT AIRFOILS IN VISCOUS FLOW**
W. A. Stevens, S. H. Goradia, and J. A. Braden Washington NASA Jul. 1971 186 p refs
(Contract NAS1-9143)
(NASA-CR-1843; ER-10896) Avail: CFSTI CSCL 04D

A computer program is described which evaluates the aerodynamic characteristics of multiple-component airfoils in subsonic, viscous flows. The number of components is limited to four elements of arbitrary arrangement. The calculated aerodynamic characteristics include pressure distributions, lift, pitching-moment, and skin friction drag up to incipient separation on any element. Within the evaluation procedures, a slot-flow analysis technique is included and both ordinary and confluent boundary layers are represented. Correlation of the program output with experimental results is provided. Author

**N71-33173#** National Aerospace Lab., Tokyo (Japan).
**SOME EFFECTS OF SYSTEMATICALLY VARIED LOCATION OF A CONCENTRATED MASS ON TRANSONIC FLUTTER CHARACTERISTICS OF SWEPTBACK THIN CANTILEVER WINGS**
Eiichi Nakai, Toshiyuki Morita, and Toshiro Takagi 1971 36 p refs In JAPANESE; ENGLISH summary
(NAL-TR-226) Avail: NTIS

An experimental investigation of some effects of systematically varied, (i. e., spanwise, longitudinal, and vertical) location of one engine-pod shaped, concentrated mass on transonic flutter characteristics of thin cantilever wings (having a sweptback angle of 20 deg in quater-chord line, and panel aspect ratio and taper ratio of 4.0 and 0.4, respectively) has been conducted in a transonic blowdown wind tunnel for flutter testing at Mach numbers between 0.759 and 0.964. The experimental results are presented in comparing the boundaries of the flutter-density and the experimental flutter-velocity coefficients of the respective wing-pod configuration tested as a function of Mach number, and also are compared with the calculated results by the matrix iteration method which employs two-dimensional incompressible unsteady flow theory as required oscillatory aerodynamic forces. The boundaries of the flutter-density and the experimental flutter-velocity coefficients are characterized by the minimum values at certain interim Mach numbers tested. Author

**N71-33174*+** National Aeronautics and Space Administration, Washington, D.C.
**AERONAUTICAL ENGINEERING A SPECIAL BIBLIOGRAPHY WITH INDEXES. SUPPLEMENT 7**
Jul. 1971 142 p refs
(NASA-SP-7037(07)) Avail: NTIS CSCL 01B

This supplement to Aeronautical Engineering - A Special Bibliography (NASA SP-7037) lists 166 reports, journal articles, and other documents originally announced in June 1971 in Scientific and Technical Aerospace Reports (STAR) or in International Aerospace Abstracts (IAA). The coverage includes documents on the engineering and theoretical aspects of design, construction, evaluation, testing, operation, and performance of aircraft (including aircraft engines) and associated components, equipment, and systems. It also includes research and development in aerodynamics, aeronautics, and ground support equipment for aeronautical vehicles. Author

**N71-33219#** Sydney Univ. (Australia). Dept. of Aeronautical Engineering.
**A NOTE ON THE SPANWISE INTEGRATION OF THE KERNAL FUNCTION IN SUBSONIC LIFTING SURFACE THEORY**
Ian Coote Nov. 1969 6 p refs *Its* Aero. Tech. Note 6093
Avail: NTIS

The kernal function procedure was used in the development of a computer program to determine the lift distribution on wings in subsonic flow. It was found that the width of the region used to isolate the pole in the spanwise integration had a marked effect on the results obtained. An investigation was carried out to find the best width for a range of wing planforms. Author

N71-33220# Sydney Univ. (Australia). Dept. of Aeronautical Engineering.

**A FORTRAN PROGRAMME FOR DETERMINING THE SUBSONIC LIFT DISTRIBUTION ON A WING, USING LIFTING SURFACE THEORY**

Ian Coote Nov. 1969 15 p refs *Its* Aero. Tech. Note 6902
Avail: NTIS

A FORTRAN computer program is presented for calculating lifting force distributions on symmetrical and cambered wings in subsonic flow. The lifting surface theory and numerical integration used in the program are outlined as well as the aerodynamic coefficients and symbols. J.M.

N71-33244*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.

**DYNAMICS OF HIGH DRAG PROBE SHAPES AT TRANSONIC SPEEDS**

Robert I. Sammonds Washington Sep. 1971 55 p refs
(NASA-TN-D-6489; A-3613) Avail: NTIS CSCL 01B

The transonic aerodynamics of spherically blunted 55 deg and 60 deg half-angle cones were studied in ballistic-range tests. Both shapes were dynamically unstable at small pitch amplitudes over a small Mach number range near 1.0. The dynamic instability was reduced by moving the center of gravity forward and was eliminated entirely by providing a full-diameter spherical segment afterbody that was made concentric with the center of gravity. Both models and variations thereof were statically stable in all tests. Author

N71-33305+ Czechoslovak Academy of Sciences, Prague. Aeronautical Research and Test Inst.

**APPLICATION OF SEVERAL METHODS BASED ON LEAST-SQUARES PRINCIPLE FOR DETERMINING LONGITUDINAL AERODYNAMIC DERIVATIVES OF AEROPLANE FROM FLIGHT TEST DATA Summary Report**

Vladislav Klein May 1969 45 p refs
(Z-12) Avail: NTIS

Problems concerning the estimation of longitudinal aerodynamic derivatives from light data are discussed from the standpoint of the identification of a linear system with a given structure. The presented methods for calculation are based on the least-squares principle. The results of the measurement are considered in the form of input and output time histories or in the form of frequency responses. The individual methods are analysed and their results compared. They are demonstrated on the numerical example for which the data of the hypothetical aeroplane were chosen and on the examples taken from real measurements on three different types of aeroplanes. Author

N71-33307*# National Aeronautics and Space Administration. Flight Research Center, Edwards, Calif.

**ANALYSIS OF A COUPLED ROLL SPIRAL MODE, PILOT INDUCED OSCILLATION EXPERIENCED WITH THE M2-F2 LIFTING BODY**

Robert W. Kempel Washington Sep. 1971 58 p refs
(NASA-TN-D-6496; H-633) Avail: NTIS CSCL 01B

During the 16 glide flights of the M2-F2 lifting body vehicle, severe lateral pilot-induced oscillations occurred on three occasions in the low-angle-of-attack, final-approach, preflare situation. These oscillations were analyzed qualitatively to determine the type and similarity and by a systems analysis to determine the root cause. The analysis was complemented by a piloted simulator study, which verified the results. The systems analysis revealed the presence of a coupled roll-spiral mode which cause the pilots to generate a closed-loop lateral instability in the low-angle-of-attack, preflare flight region. A systems analysis, a piloted simulator study, and flight data showed that the addition of a fixed center fin lessened the pilot-induced-oscillation tendencies in the critical flight region. Author

N71-33395*# National Aeronautics and Space Administration Langley Research Center, Langley Station, Va.

**DRAG COEFFICIENTS FOR PARTIALLY INFLATED FLAT CIRCULAR PARACHUTES**

Stanley H. Scher and Irene G. Young Washington Sep. 1971 11 p refs
(NASA-TN-D-6423; L-7723) Avail: NTIS CSCL 01C

Free-body tests were made in a spin tunnel to determine drag coefficients for 1.07 m diameter flat circular parachutes when restrained by wire frames in a series of shapes representing those that parachutes assume during the inflation process. Both high-porosity (stable) and low-porosity (unstable) parachutes were investigated. The results obtained should be applicable to inflation analyses for flat circular parachutes. Author

N71-33402# Aeronautical Research Labs., Melbourne (Australia).

**A WIND TUNNEL INVESTIGATION OF LEVEY'S SHOCK-FREE AEROFOIL**

D. A. Secomb Aug. 1970 41 p refs
(ARL/Aero-325) Avail: NTIS

Surface pressure measurements and schlieren photographs of the flow about a 5.0 in. chord model of Levey's shock free airofoil are presented. The results cover the Mach number range 0.60–0.95 and the Reynolds number range 0.2 million to 0.9 million. A few results at nonzero angle of attack are included. At the higher Reynolds numbers the results suggest that a low loss transonic compression from a local Mach number of about 1.14 does occur, at a free stream Mach number somewhat in excess of the design value, 0.80. Unsteady wavelets are present in the compression region near 0.6 of chord, but boundary layer separation does not occur. Agreement with the predicted inviscid distribution is reasonable. At the lower Reynolds numbers flow separation from the surface occurs near 0.6 of chord. The reattachment point moves forward with the increase of Reynolds number so that at about 0.45 million the separation is suppressed. Leading edge roughness bands were present at all times. The effect of a small increase of angle of attack on the upper surface pressure distribution at Mach number 0.8 is very similar to the effect of a small increase in Mach number. The model profile errors and their effects are discussed in some detail. The influence of the model at the upper and lower slotted test section walls is found to be small. Author

N71-33403# McGill Univ., Montreal (Quebec). Dept. of Mechanical Engineering.

**A COMPUTER-PLOTTER PROGRAM ON JOUKOWSKI AIRFOIL**

J. H. T. Wu, K. S. Wong, and P. P. Ostrowski Apr. 1971 26 p refs
(Tech-71-4) Avail: NTIS

Steady, incompressible flow about a Joukowski airfoil section is simulated at moderate angles of attack using a digital computer and plotter. The effect of various transformation parameters as well as the streamline pattern and pressure distribution about the airfoil is illustrated. Numerical integration of the pressure distribution at 6.50 angle of attack yields a lift coefficient that agrees favorably with known experimental results. The value of the simulation technique as a teaching tool is demonstrated. The method is shown to be particularly useful for flow visualization as all the basic features of the Joukowski transformation and the potential flow streamline patterns are clearly depicted. Since only relatively unsophisticated computing methods are required, the simulation process provides a flexibility that is conveniently coupled with an obvious time saving and economic advantage as compared to that done by slide rules or desk calculators. Author

N71-33546*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
**CALCULATION OF CAMBER USING SLENDER WING THEORY AT MACH NUMBER 1.0**
William B. Igoe Sep. 1971 73 p refs
(NASA-TM-X-2311; L-7666) Avail: NTIS CSCL 01A

A calculation procedure based on slender wing theory at Mach number 1.0 is presented for the determination of the mean line camber ordinates for laterally symmetrical wings with polygonal planforms. A uniform chordwise load and a continuous but otherwise arbitrary spanwise load distribution is assumed. The procedure is generally limited to slender wings at high subsonic speeds and low lift coefficients. Graphs of functions required in the calculation procedure are presented. In addition, an application of the method of calculation for a variable-sweep wing planform is described and some calculated camber results are shown. Although the slender wing theory for Mach number 1.0 is considered to be inadequate for the calculation of the detailed shape of airfoil section camber for supercritical wings designed for near-sonic speeds, a comparison with experimental results shows that it predicts the general magnitude and trend of the spanwise variation of the wing twist angle. Author

N71-33699# Weapons Research Establishment, Salisbury (Australia). Dept. of Supply.
**PRESSURE DISTRIBUTIONS ON PLANAR DELTA WINGS ATTACHED TO CYLINDRICAL BODIES IN SUPERSONIC FLOW. PART 3: THEORETICAL RESULTS FOR SONIC LEADING EDGE, ANGLE OF ATTACK CASE**
Judith E. Barrett Sep. 1970 65 p refs
(WRE-TN-HSA-186) Avail: NTIS

A method of calculating the linearized pressure fields on supersonic planar wing and quasi-cylindrical body combinations is used to find the theoretical pressure distributions for a wing-body combination consisting of a sonic-leading-edged delta wing and cylindrical body in supersonic flow. Results are given for the case where the combination is at an angle of attack, and the wing is taken to be of zero thickness. Comparisons with experimental data demonstrate that for this configuration the linearized theory may be used successfully to evaluate the pressure distribution. Author

N71-33776*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
**LOW-SPEED STATIC WIND-TUNNEL INVESTIGATION OF A HALF-SPAN FUSELAGE AND VARIABLE SWEEP PRESSURE WING MODEL**
John E. Lamar and L. Wayne McKinney Washington Aug. 1971 324 p refs
(NASA-TN-D-6215; L-7548) Avail: NTIS HC $6.00/MF $0.95 CSCL 01B

The experimental balance and pressure data obtained from tests of an untwisted variable sweep wing with an outboard pivot exhibited nonlinearities in both total normal force coefficient and pitching moment coefficient curves for all sweep angles and fuselage conditions. These total effects have been traced back through the section data and pressure distributions to find the causes. The causes of these nonlinearities were found to be: (1) separation of flow on the outer panel; and (2) a leading edge vortex flow on the inner panel. A fuselage added to the wing had little effect on the aerodynamic characteristics. Predictions of wing loadings and performance characteristics were made by using the modified Multhopp method and a comparison with experimental results indicated reasonable agreement. The changes in span loading as a result of leading edge shed vortex formation and flow separation at the higher angles of attack caused an increase in the induced drag parameter. Author

N71-33794# Office National d'Etudes et de Recherches Aerospatiales, Paris (France).
**TRANSONIC TESTING OF THE ENGINE NACELLE AIR INTAKE AND AFTERBODY [ENTREE D'AIR ET ARRIERE-CORPS DE FUSEAU-MOTEUR EN TRANSSONIQUE]**
Jacky Leynaert 1971 11 p refs In FRENCH; ENGLISH summary
(ONERA-TP-943) Avail: NTIS

An example is presented of a double-flux engine nacelle at high subsonic Mach numbers, the investigation being made at high Reynolds numbers with two separate models for the air intake and the afterbody. The test on the afterbody shows that the conditions of variable jets do not react significantly on the upstream flow around the nacelle intake and cowl, apart from the immediate vicinity of the exhaust; this fact justifies the large scale, study of the air intake with a model supported downstream by a cylindrical tube replacing the jet. In the same way, mass-flow rate variations of the air intake do not react on the flow around the afterbody, in a given margin; this allows the study of the afterbody on a upstream sting. Signification and limits of these studies are discussed according to the test results. Author

N71-33803*# National Aeronautics and Space Administration, Washington, D.C.
**THEORETICAL AND EXPERIMENTAL TESTING ON JET FLAP WINGS. PART 1: TESTING OF A RECTANGULAR WING AT VARIOUS ASPECT RATIOS [THEORETISCHE UND EXPERIMENTELLE UNTERSUCHUNGEN ON STRAHLKLAPPENFLUGELN. GEIL 1: UNDERSUCHUNGEN ARE RECHTECKFLUGELN VON VERSCHIEDENEN SEITENVERHALTNISSER]**
A. Das (German Res. Center for Flight, Braunschweig) Sep. 1971 83 p refs Transl. into ENGLISH from the German report
(NASA-TT-F-13715) Avail: NTIS CSCL 01A

Theoretical and experimental information is provided about the lift and pitching moment distribution on jet flap wings of a rectangular design with various aspect ratios. In this case the jet impulse coefficients were varied in the range from 0 to 2.0. Theretical computation of the lift distribution was made according to the airfoil theory with the adoption of the necessary profile data for slot wings. An airfoil model with an end plate was used for the experimental research. The wing had adjustable blowing slots for jet angles 0 deg; 30 deg and 60 deg. The aspect ratio could be changed by shifting the wing in the cross direction with the end plate. In this way the effective aspect ratios of 2.75; 3.8 and 4.5 for the three wing lengths used in consideration of an end plate correction were obtained. The tests include measurement of the static pressure on the airfoil and measurements of the total pressure in the wake in order to determine the jet shape. Author

N71-33840# Office National d'Etudes et de Recherches Aerospatiales, Paris (France).
**STUDY OF WALL PRESSURE FLUCTUATIONS ON REAR OF CONE-CYLINDER BODY INTRANSONIC FLOW [ETUDE DES FLUCTUATIONS DE PRESSION PARIETALES, EN ECOULEMENT TRANSSONIQUE, SUR ENSEMBLE CONE-CYLINDRE PRESENTANT UN RETREINT]**
Alain Bourgine 1971 31 p refs In FRENCH; ENGLISH summary Presented at Symp. IUTAM Sur Les Couches Limites Instationnaires, Quebec, 24-28 May 1971
(TP-942) Avail: NTIS

An experimental study of the transonic buffeting environment of a cone-cylinder-cone missile type body in the Mach number range from M approximately or = 0.7 to M approximately or = 1.1 is reported. Experiments are conducted in a transonic wind tunnel to determine the distribution of static and fluctuating pressures on the walls of two perfectly rigid and fixed models of different scale.

Spectral analysis of the data and visualization of the near flow field by shadowgraphs are shown. High intesnity fluctuating pressures are found at the rear of the models, mainly at high subsonic Mach numbers. This is due to the separation of the flow and the instability of the shock wave position. The effects of model scale, angle of attack, dynamic pressure and Reynolds number are studied. Generalized non-dimensional spectra give some confidence in the application of these results to full scale missiles. Author

**N71-33928#** Technische Hogeschool, Delft (Netherlands).
**A METHOD TO DERIVE ANGLE OF PITCH, FLIGHT-PATH ANGLE AND ANGLE OF ATTACK FROM MEASUREMENTS IN NONSTEADY FLIGHT**
R. J. A. W. Hosman Apr. 1971 107 p
(VTH-156) Avail: NTIS

A method is described to determine the angle of pitch theta, the flight-path angle gamma and the angle of attack alpha of an aircraft during steady or nonsteady flight. These angles are determine by integration of the rate of pitch Q and the specific forces A sub x and A sub z and not by directly measuring these angles. Errors in the estimates of the initial conditions of the integrations and of the zeroshifts in the measurements of q, A sub x and A sub z are corrected for by comparing the computed and the measured values of the change in altitude and airspeed. An error analysis is carried out, to determine the accuracy with which the angles theta, gamma and alpha are determined by the described method for steady as well as for nonsteady flight. Author

# 02 AIRCRAFT

**Includes fixed-wing airplanes, helicopters, gliders, balloons, ornithopters, etc; and specific types of complete aircraft (e.g., ground effect machines, STOL, and VTOL); flight tests; operating problems (e.g., sonic boom); safety and safety devices; economics; and stability and control. For basic research see: 01 Aerodynamics. For related information see also: 31 Space Vehicles; and 32 Structural Mechanics.**

**N71-32811#** Royal Aircraft Establishment, Farnborough (England). Structures Dept.
**VIBRATION LEVELS EXPERIENCED IN TAKE-OFF ON A LARGE FLEXIBLE AIRCRAFT**
H. Hall London Aeron. Res. Council 1971 30 p refs
Supersedes RAE-TR-68193; ARC-32600
(ARC-CP-1149; RAE-TR-68193; ARC-32600) Copyright. Avail: NTIS; HMSO: 40p; BIS: $1.60

On the basis of some American theoretical predictions and flight experience it was suggested by Zbrozek that there was a possibility of unacceptably large responses at the cockpit of the Concorde aircraft during takeoff. In order to provide experimental evidence against which a general theoretical model of takeoff response could be checked, six takeoff runs are made with a VC 10, and the cockpit accelerations are measured. ESRO

**N71-32818#** Mississippi State Univ., State College. Dept. of Aerophysics and Aerospace Engineering.
**XV-11A FLIGHT TEST PROGRAM**
L. J. Mertaugh, S. C. Roberts, and N. S. Kiran Feb. 1971 116 p
(Contract DA-44-177-AMC-266(T))
(AD-724124; AASE-69-7; USAAVLABS-TR-70-37) Avail: NTIS CSCL 1/3

The report presents the results of a test program that was conducted to evaluate the performance and stability and control characteristics of the XV-11A aircraft. The aircraft is a research vehicle designed to perform basic aerodynamic flight research in the areas of high-lift boundary layer control, propeller thrust augmentation, low drag geometry, and STOL aircraft handling qualities. The aircraft incorporates a number of unique design features including glass fiber reinforced plastic construction; a distributed-suction, high-lift boundary layer control system; a variable-camber wing; and a shrouded propeller. The test data show that the aircraft has sufficient performance and stability and control for conducting low-speed aerodynamic research. Handling qualities research would be limited by the high longitudinal and directional control force gradients. Although low stall speeds are demonstrated, the increment in lift due to the boundary layer control system is less than anticipated. Aircraft performance is somewhat limited by propeller deficiencies due to high blade loading. Author (GRA)

**N71-32854#** National Transportation Safety Board, Washington, D.C.
**AN ANALYSIS OF AIRCRAFT ACCIDENT DATA: U. S. GENERAL AVIATION, 1969**
29 Mar. 1971 21 p
Avail: NTIS

The growth of general aviation during the year 1969 and an analysis of aircraft accidents are presented. Subjects discussed are: (1) accident analysis, (2) collisions between aircraft, (3) accident analysis by cause and related factors, (4) growth indices, and (5) injuries to flying personnel. Author

**N71-32927#** Air Force Systems Command, Wright-Patterson AFB, Ohio. Aero Propulsion Lab.
**PERFORMANCE AND ACOUSTIC TESTING OF A VARIABLE CAMBER PROPELLER Technical Report, Mar.–Jul. 1970**
Donald P. McErlean and Donald E. Edwards Feb. 1971 99 p refs
(AD-724145; AFAPL-TR-70-80) Avail: NTIS CSCL 1/3

The report presents the test results obtained from a series of performance and acoustic near-field measurements on a propeller fitted with a variable camber feature. The subject propeller effects a change in camber by deflecting a flap positioned along the 72% chordal line of each blade. The tests were conducted on a 10,000 horsepower electric whirl rig. The tests represent the only test data available on this unique propeller configuration which is considered to have good potential for V/STOL applications. Author (GRA)

**N71-32931#** Army Electronics Command, Fort Monmouth, N.J.
**COLLISION GEOMETRY FORMULAE AND APPLICATION TO COLLISION WARNING TECHNIQUES**
Anthony Musillo Mar. 1971 39 p
(AD-723977; ECOM-3406) Avail: NTIS CSCL 1/2

The paper discusses two dimensional collision geometry in which straight and nonaccelerated flight paths are assumed. A derivation of the time dependence of the range (R), relative velocity (dR/dt), and relative acceleration (2nd dR/dt) will be presented and the quantities expressed as a function of R. The time to collision (tau) will be discussed, also. These quantities are applied to realistic collision geometries based on present Army aircraft operations. Also, a discussion of relative velocity versus range curves with reference to tau min (where tau = dR/(dR/dt)) and constant range warning lines is given. These parameters are incorporated in present state-of-the-art techniques such as the Doppler and range increment techniques. The former technique attempts to detect any change in the Doppler frequency when tau = tau min ( in this case, 15 seconds). A change in the Doppler frequency indicates a noncollision course. The range increment technique measures differences in ranges over small constant time intervals and uses these range changes to obtain tau. A sample error measurement

analysis in one of the low range rate change situations gives an indication of the magnitude of the range error measurement.
Author (GRA)

**N71-32981#** Air Force Systems Command, Wright-Patterson AFB, Ohio. Flight Dynamics Lab.
**THE PAPER-PILOT: A DIGITAL COMPUTER PROGRAM TO PREDICT PILOT RATING FOR THE HOVER TASK**
James D. Dillow Mar. 1971 99 p refs
(AD-724144; AFFDL-TR-70-40) Avail: NTIS CSCL 1/3

A mathematical model for predicting the pilot rating of the flying qualities of a VTOL aircraft in the precision hover mode is described. The model includes the following elements: the longitudinal equations of motion for the VTOL aircraft in hover; a stochastic gust model which describes disturbances to the aircraft; a fixed form pilot model which has four free parameters; and a cost functional which is made up of measures of aircraft performance and pilot workload. The four free pilot parameters of the pilot model are selected to minimize the cost functional. These parameters are adjusted to ensure a 20% stability margin in pilot gains and then used to compute a paper pilot rating of the flying qualities of the VTOL aircraft in the precision hover mode. The mathematical equations and digital computer program used to exercise the model are described. The paper pilot rating was computed for 79 aircraft configuration/gust intensity combinations. The aircraft configurations considered include cases with control lag, stability augmentation system lag, and limited pitch rate authority in the stability augmentation system. The paper pilot ratings are compared to actual pilot ratings obtained in fixed base simulation. The difference between the actual pilot ratings and the paper pilot rating has a mean of .14 and a standard deviation of .63 out of a 10 point rating scale.
Author (GRA)

**N71-32992#** Dynamic Science, Phoenix, Ariz. AvSER Facility.
**CRASHWORTHY FUEL SYSTEM DESIGN CRITERIA AND ANALYSES Final Report**
Neva B. Johnson Fort Eustis, Va. US Army Air Mobility Res. and Develop. Lab. Mar. 1971 131 p refs
(Contract DAAJ02-69-C-0030)
(AD-723988; AV-SER-1500-70-49; USAAVLABS-TR-71-8) Avail: NTIS CSCL 1/3

Comprehensive design criteria for crashworthy aircraft fuel systems were developed from the design philosophies of the U. S. Army and several aircraft manufacturers, as well as from Dynamic Sciences experience in the development and testing of crashworthy fuel systems. Eight aircraft fuel systems currently in the U. S. Army inventory were analyzed, and unsatisfactory areas in regard to crashworthiness were determined. Most of these areas were common to the majority of the aircraft studied. Recommendations for improving the crash resistance of these hazardous areas were proposed.
Author (GRA)

**N71-33005#** Army Test and Evaluation Command, Aberdeen Proving Ground, Md.
**AIRCRAFT ANTI-ICING/DE-ICING Final Report**
24 Mar. 1971 16 p
(AD-724082; MTP-7-3-528) Avail: NTIS CSCL 1/3

The document provides procedures for evaluating the capability of anti-icing/de-icing equipment on aircraft to perform satisfactorily while the aircraft is operated at all expected speeds, altitudes and weather conditions.
Author (GRA)

**N71-33006#** Air Weather Service, Scott AFB, Ill.
**LIGHTNING HAZARD TO AIRCRAFT**
Herbert S. Appleman Apr. 1971 13 p refs revised
(AD-724092; AWS-TR-179-Rev) Avail: NTIS CSCL 1/3

The report presents the latest available information on lightning hazards to jet aircraft. Included are the temperature and altitude range where most strokes are encountered, a brief discussion of the type of damage likely to be incurred, and a somewhat more detailed look into the possibility of fuel-tank explosions due to lightning and electrostatic discharges. It appears that, while the possibility of such explosions is small, aircraft using JP-4 fuel are generally more vulnerable to this hazard than those using gasoline or kerosine. It is concluded from this and other hazards associated with JP-4 that jet passenger aircraft, at least, should use kerosene fuels where possible.
Author (GRA)

**N71-33015#** Boeing Co., Philadelphia, Pa. Vertol Div.
**STOL HIGH LIFT DESIGN STUDY. VOLUME 3: BIBLIOGRAPHY Final Report, Jan. – Dec. 1970**
Fred May and Colin A. Widdison Wright-Patterson AFB, Ohio AFFDL Apr. 1971 338 p refs
(Contract F33615-70-C-1277)
(AD-724186; D210-10201-2; AFFDL-TR-71-26-Vol-2) Avail: NTIS CSCL 1/3

The volume consists of a bibliography that resulted from a literature search for aerodynamic information related to seven lift/propulsion concepts suitable for STOL aircraft. The bibliography contains references to approximately 900 reports classified by concept and by technological area.
Author (GRA)

**N71-33016#** Boeing Co., Philadelphia, Pa. Vertol Div.
**STOL HIGH LIFT DESIGN STUDY. VOLUME 1: STATE OF THE ART REVIEW OF STOL AERODYNAMIC TECHNOLOGY Final Report, Jan. – Dec. 1970**
Fred May and Colin A. Widdison Wright-Patterson AFB, Ohio AFFDL Apr. 1971 208 p refs
(Contract F33615-70-C-1277)
(AD-724185; D210-1020-1; AFFDL19TR-71-26-Vol-1) Avail: NTIS CSCL 1/3

The state of the art of STOL aerodynamic technology for selected lift/propulsion concepts was surveyed to identify the available test data and prediction methods in the literature. The report consists of two volumes. In Volume I important areas of technology and information necessary for the evaluation of STOL aircraft aerodynamics are listed the aerodynamic test data and prediction methodology relevant to the deflected slipstream and externally blown flap concepts are assessed, with emphasis on the latter an empirical method for the prediction of the longitudinal aerodynamic characteristics of externally blown flap configurations is presented and high-lift technology for five lift/propulsion concepts is assessed in application to a medium-sized STOL transport.
Author (GRA)

**N71-33076#** Honeywell, Inc., St. Paul, Minn. Research Dept.
**IFR STEEP ANGLE APPROACH: EFFECTS OF SYSTEM NOISE AIRCRAFT CONTROL AUGMENTATION VARIABLES Final Report, Jan. 1969 – Jun. 1970**
James D. Wolf and Mike F. Barrett Jul. 1970 322 p refs
(Contract N00014-68-C-0191)
(AD-724336; JANAIR-700810; Rept-12571-FR2)

The objective of this study was to investigate, by means of real-time man-in-the-loop simulation techniques, piloting performance as influenced by approach-signal degradation and aircraft control-augmentation variables during IFR steep-angle approaches and landings with vertical-lift aircraft. Simulation evaluations also included aircraft-type, display-format, approach-angle, and display-quickening variables to increase the generality of study results. Variable-velocity simulations of Bell UH-1 and Ryan XV-5 aircraft were utilized as test vehicles. Interpreted within the constraints imposed by the simulations, study results indicated that increased filtering of measurement noise is beneficial during

approach but may have a degrading effect during hovering flight. Generally, both flight-path error and pilot control activity increased with increased measurement noise. With one exception data trends also indicated improved performance with aircraft outer-loop control augmentation. Author (GRA)

**N71-33162#** Royal Aircraft Establishment, Farnborough (England).
**CATALOGUE OF ENEMY AIRCRAFT REPORTS, 1939–1946**
D. I. Raitt comp. Mar. 1969 126 p refs
(RAE-LIB-BIB-312) Avail: NTIS

Bibliography on Japanese, German, and Italian military aircraft and components during the Second World War is listed. ESRO

**N71-33180#** Defense Documentation Center, Alexandria, Va.
**PARACHUTE TECHNOLOGY, VOLUME 1 Bibliography Report, Mar. 1954–Sep. 1970**
May 1971 181 p refs
(AD-724500; DDC-TAS-70-87-1) Avail: NTIS CSCL 1/3

The references in this bibliography are sorted into seven sections. Section I pertains to the testing or the results of testing of parachutes as a whole configuration; Section II to the theoretical and empirical studies of parachute aerodynamics; Section III to the materials involved in parachute systems; Section IV to the release mechanisms; Section V to parachute jumping and packs; Section VI to air drop operations; and Section VII to miscellaneous references. Author (GRA)

**N71-33211*#** National Aeronautics and Space Administration. Flight Research Center, Edwards, Calif.
**COMPARISONS OF IN FLIGHT F-111A INLET PERFORMANCE FOR ON AND OFF SCHEDULED INLET GEOMETRY AT MACH NUMBERS OF 0.88 TO 2.18**
Richard A. Martin and Donald L. Hughes Washington Sep. 1971 47 p refs
(NASA-TN-D-6490; H-654) Avail: NTIS CSCL 01B

Total and static pressure data from the left inlet of a prototype F-111A airplane were recorded over a large portion of the operating range during automatically scheduled and manually controlled off-schedule positioning of the two-cone compression spike. These data were used to derive inlet performance parameters which indicated that a relatively wide range in performance may be expected during normal operation. The data showed that the preset controller schedule produced nearly optimum performance degradation occurred during off-schedule operation. Compressor stalls due to small inlet geometry changes were found to be most likely to occur at high supersonic Mach numbers, and more range in second-cone angle was available before a compressor stall occurred with a blunt-lip cowl than with a sharp-lip cowl. Trends of total pressure recovery and distortion in flight data were similar to trends in both full-scale and 1/6-scale model data. Author

**N71-33239*#** National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
**DEPLOYMENT LOADS DATA FROM A FREE FLIGHT INVESTIGATION OF ALL-FLEXIBLE PARAWINGS AT SMALL SCALE**
Delwin R. Croom Washington Aug. 1971 441 p refs
(NASA-TM-X-2307; L-7732) Avail: NTIS HC $6.00/MF $0.95 CSCL 01B

A free-flight investigation to determine the deployment characteristics of all-flexible parawings was made. Both single-keel and twin-keel parawings having wing areas of 37.16 sq cm with a five-stage reefing system were tested by use of a bomb-type instrumented test vehicle. The system was launched from either a C-130 or a B-66 carrier aircraft and a programer parachuste was used to bring the test vehicle to a proper dynamic pressure and near-vertical flight path prior to deployment of the parawing system. The free-flight deployment loads data obtained in the form of time histories of individual suspension-line loads, reefing-line loads, and total loads are presented. Author

**N71-33278#** Army Board for Aviation Accident Research, Fort Rucker, Ala.
**ARMY MIDAIR COLLISIONS**
Morris L. Marty and Leroy B. Spivey 1971 25 p refs
(AD-724682; USABAAR-71-1) Avail: NTIS CSCL 1/2

The report contains analyses of 56 Army midair collisions which occurred during the period January 1963 to November 1969 and conclusions and recommendations based on the analyses. Author (GRA)

**N71-33283*#** Edgerton, Germeshausen and Grier, Inc., Albuquerque, N.Mex.
**SONIC BOOM IN TURBULENCE**
W. A. Horning Washington NASA Sep. 1971 82 p refs
(Contract NAS1-9284)
(NASA-CR-1879) Avail: NTIS CSCL 20A

Statistics of random overpressure peaks observed in a single sonic boom at ground are derived. The Fourier transform of the wave equation for sound in weak homogeneous turbulence is the starting point. A temporal propagation equation for the spectral density of scattered waves is derived including multiple scattering effects insofar as they are important in weak turbulence at long sonic pathlengths. Author

**N71-33312#** United Aircraft Corp., Stratford, Conn. Sikorsky Aircraft Div.
**ROTOR BLADE BOUNDARY LAYER CALCULATION PROGRESS Final Report**
David R. Clark and Douglas R. Arnoldi Mar. 1971 236 p refs
(Contract DAAJ02-69-C-0039)
(AD-723989; USAAVLABS-TR-71-1) Avail: NTIS CSCL 1/3

The development of the turbulent compressible boundary layer on two typical helicopter rotors, for a range of hover conditions, has been calculated using two different analytical methods: the differential method, which uses the differential form of the boundary layer momentum equations and solves for the local velocity gradients, and the integral method, which uses the integrated form of the momentum equations and solves for the development of the characteristic boundary layer thickness parameters and skew angle. Both methods decouple the chordwise and spanwise boundary layer equations without making any small crossflow assumptions. The effects of rotational speed, vortex-induced crossflows, surface curvature, and applied chordwise pressure gradients were evaluated separately and in combination to simulate rotor airfoil boundary layer growth. Author (GRA)

**N71-33325*#** Princeton Univ., N.J.
**TURBULENCE AND LONGITUDINAL FLYING QUALITIES**
James A. Franklin Washington NASA Jul. 1971 184 p refs
(NASA Order W-12994)
(NASA-CR-1821) Avail: NTIS CSCL 01B

The results of an experimental investigation into the influences of atmospheric turbulence on longitudinal flying qualities are presented. In-flight evaluations of various combinations of simulated turbulence disturbances and open loop airplane dynamics were made for the ILS approach task. Test configurations were chosen to permit an independent study of the effects of turbulence to be made for a set of satisfactory longitudinal dynamics. Further testing was performed for a selective combination of turbulence and dynamics characteristics to assess their interacting influences on flying qualities for the ILS task. The turbulence disturbances were

defined in terms of rms magnitudes of the pitch and heave components, the bandwidth or frequency content of the turbulence power spectrum, and the correlation between pitch and heave disturbances. Variations of longitudinal dynamics were made in the short period natural frequency (or angle of attach stability), shorth period damping, and lift curve slope. Data in the form of pilot opinion ratings and commentary, and time histories of airplane response, control inptus, and simulated turbulence disturbances were obtained. The time histories were digitally processed for rms measures of the precision of task performance and the pilot's control workload. Author

**N71-33393*#** Rochester Applied Science Associates, Inc., N.Y.
**THE EFFECTS ON NONUNIFORM SWASH PLATE STIFFNESS ON COUPLED BLADE CONTROL SYSTEM DYNAMICS AND STABILITY. PART 1: ANALYSIS AND APPLICATION**
Vincent J. Piarulli Washington NASA Sep. 1971 81 p ref
(Contract NAS1-9496)
(NASA-CR-1817; Rept-70-70) Avail: NTIS CSCL 20D

The results are presented of a study investigating the effects of an anisotropically mounted flexible swash-plate, including blade out-of-track, on the vibratory and mechanical stability characteristics of helicopter rotor systems. The analysis which was developed is based on a combined Laplace transform and associated matrix approach. The program yields complex eigenvalues which indicate frequency and rate of growth or decay of a natural mode of the complex system. Blade modal response and swash-plate motion corresponding to a given eigenvalue are predicted. Author

**N71-33438#** Lundberg (Bo), Bromma (Sweden).
**IS CIVIL SUPERSONIC AVIATION JUSTIFIED?**
Bo Lundberg 5 Jul. 1971 51 p refs Presented at Meeting of the Council of Europe, Stockholm, 6 Jul. 1971
(BL-147) Avail: NTIS

A balance sheet is presented of the pros and cons of the SST, in its currently conceived form, for use in worldwide civil air operations. Discussed are: (1) need for the SST; (2) economics; (3) safety; (4) production costs; (5) fuel consumption; (6) cosmic radiation risks to passengers; (7) climatological change risks; (8) airport noise; and (9) sonic booms. The author concludes that the serious drawbacks to the SST make it imperative that the SST be prevented from being introduced into regular operation. A.L

**N71-33439#** Lundberg (Bo), Bromma (Sweden).
**OZONE: SORRY, BUT THERE'S STILL MORE TO SAY ON THE SST**
*In its* Is Civil Supersonic Aviation Justified? 5 Jul. 1971 3 p Excerpt from the New York Times, 30 May 1971, Science (See N71-33438 20-02)
Avail: NTIS

Excerpts are presented from a New York Times article, and editorial, on the possible effects of SST exhaust on the ozone content of the stratosphere. Dr. Johnston of the University of California at Berkeley contends that the nitric oxides from a fleet of 500 SST's operating an average of seven hours a day could reduce the ozone content of the atmosphere by half within less than one year, and that SST's would wipe out virtually all ozone in the lower stratosphere where the planes would operate. Predictions are also made of the effects this depletion would have on humans, animals, weather, climate, and rates of ozone production. A.L

**N71-33440#** Lundberg (Bo), Bromma (Sweden).
**[STATEMENT TO THE SECOND MEETING OF THE ICAO SONIC BOOM PANEL]**
*In its* Is Civil Supersonic Aviation Justified? 5 Jul. 1971 10 p Held 12–21 Oct. 1970 (See N71-33438 20-02)
Avail: NTIS

The SST sonic boom carpets and their potential effects over land and sea areas are discussed. A.L

**N71-33441#** Lundberg (Bo), Bromma (Sweden).
**GENERAL COMMENTS ON RAPPORTEUR'S REPORT NO. 3**
*In its* Is Civil Supersonic Aviation Justified? 5 Jul. 1971 2 p (See N71-33438 20-02)
(BL-139; SBP-WP/6) Avail: NTIS

The two different approaches to solving probable and possible effects of sonic booms resulting from future extensive SST operations are discussed. The two approaches are: (1) the known facts only; and (2) attempt of full assessment. The pros and cons of the two methods are briefly evaluated. A.L

**N71-33517*#** National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
**AN INVESTIGATION OF A FULL-SCALE ADVANCING BLADE CONCEPT ROTOR SYSTEM AT HIGH ADVANCE RATIO**
Robert H. Stroub, Michael D. Falarski, John L. McCloud, and Paul T. Soderman Aug. 1971 54 p Prepared jointly with Army Air Mobility Res. and Develop. Lab., Moffett Field, Calif.
(NASA-TM-X-62081) Avail: NTIS CSCL 01B

Modern helicopters have been limited in high speed capability and cruise performance by stall of retreating blade and by compressibility effects of advancing blade. One technique for minimizing those adverse effects is to locate the rotor's total life centroid on the advancing side of the rotor disk. The retreating blade lift requirements would then be greatly lessened, and the advancing blade would be operating at conditions favorable for better lift to drag ratios. A rotor system has been built based upon this lift offset or advancing blade concept (ABC). This ABC rotor system featured two, counter rotating coaxial rotors utilizing blades that were very stiff in torsion and in flatwise and chordwise bending. The ABC rotor system was tested in the 40 by 80 foot wind tunnel to demonstrate the system's performance capability, rotor loads, and to determine stability and control power derivatives over an advance ration range of 0.2 to 0.9. Data were obtained over a range of lift and propulsive force. Author

**N71-33545#** Aeronautical Research and Test Inst., Prague (Czechoslovakia).
**ON AIRCRAFT LONGITUDINAL MOTION AFTER BOUNDARY LAYER CONTROL SYSTEM FAILURE DURING TAKE-OFF AND LANDING Summary Report**
Vladimir Silhanek Oct. 1969 29 p refs *Its* Zprava Vzlu Z-13
Avail: NTIS

The aircraft longitudinal motion during take-off and landing, caused by loss of lift, arising after BLC system failure is studied. The theoretical part of this study deals with the estimation of the critical altitude of BLC failure and with the analysis of the influence of some parameters. This task is solved as a non-classical variation problem and the method of Pontrjagin's principle of maximum is applied. Some flight measurements on the E 33 test aircraft with BLC by blowing, where the BLC system failure was simulated. Some comparisons of these flight measurements and the results of theory are also presented. Author

**N71-33547#** National Aerospace Lab., Tokyo (Japan).
**STUDIES ON PSD METHOD FOR AIRCRAFT STRUCTURAL DESIGN FOR ATMOSPHERIC TURBULENCE**
Kazuyuki Takeuchi and Kosaburo Yamane Jan. 1971 36 p refs

In JAPANESE; ENGLISH summary
(NAL-TR-233) Avail: NTIS

The currently adopted gust criterion for airplane structural strength is based on discrete gusts of the (1-cos) type. With the increase of airplane speed and the structural flexibility, the discrete gust criterion has been thought to be insufficient for the examination of gust loads and structural strength, especially for civil transport. A power spectral density (PSD) method is discussed. Some comments on the proposed PSD method and the calculated results on the YS-11 twin turboprop transport by this method are presented. Author

**N71-33585#** National Aerospace Lab., Tokyo (Japan).
**TASK ANALYSIS OF JET TRANSPORT (DC-8)**
Kazuo Higuchi, Moriyuki Momona, Noriko Miyoshi, Masanori Okabe, and Hiroyasu Kawahara 1970 180 p refs In JAPANESE; ENGLISH summary
(NAL-TR-215) Avail: NTIS CSCL 01B

As an aid to get an objective understanding of the behaviour of pilot-vehicle system, a task analysis of DC-8 pilots was carried out. Task was defined as a minimum unit of work made of information acquisition, central processing and control motion. The following implications were obtained; (1) information necessary to control airplane is not presented to pilots in the form which makes pilots able to grasp the entire situation, (2) the process of judgement is not specified clearly and liable to be subject to indivisual arbitrary standard of judgement, (3) at take-off and landing, legs and arms of captain among other crews are occupied by controls, (4) many unspecified tasks are assigned to pilots, (5) there are many tasks in which pilots can be replaced with automatic devices, (6) it is desirable to exempt captain from those tasks which he must perform as a simple operator, and also to lessen his task load. Furthermore, there is little mobility of task allocation among crews, (7) discrete tasks are liable to be left unperformed without confirming the execution of them, and (8) the appropriate warning device to prevent pilots from wrong operations is not provided. Author

**N71-33625*#** Translation Consultants, Ltd., Arlington, Va.
**ON THE WAY TOWARDS THE HYPERSONIC TRANSPORT [VERS L'AVION HYPERSONIQUE]**
C. Dousset Washington NASA Sep. 1971 22 p Transl. into ENGLISH from l'Aeronautique et l'Astronautique (France), no. 26, Feb. 1971 p 37–46
(Contract NASw-2038)
(NASA-TT-F-13793) Avail: NTIS CSCL 01B

The mission, aircraft, traffic volume, operating conditions as well as the economic aspect of a commercially viable hypersonic transport are described. Author

**N71-33678#** Federal Aviation Administration, Oklahoma City, Okla.
**AIRFRAME AND POWERPLANT MECHANICS: GENERAL HANDBOOK**
1970 505 p
(FAA-AC-65-9) Avail: NTIS HC $6.00/MF $0.95

This handbook was developed by the Federal Aviation Administration as the first of three handbooks designed as study manuals for persons preparing for mechanic certification with airframe or powerplant rations, or both. It is intended that this handbook will provide basic information on principles, fundamentals, and technical procedures in the subject matter areas common to both the airframe and powerplant ratings. Emphasis in this volume is on theory and methods of application. Author

**N71-33937#** Serendipity Associates, Arlington, Va. Operations Div.
**A STUDY OF THE MAGNITUDE OF TRANSPORTATION NOISE GENERATION AND POTENTIAL ABATEMENT. VOLUME 3: AIRPORT/AIRCRAFT SYSTEM NOISE Final Report**
Nov. 1970 317 p refs
(Contract DOT-OS-A9-018)
(OST-ONA-71-1-Vol-3) Avail: NTIS

Alleviation of the airport noise problem involves changes to aircraft, airport, and airport surroundings. Individual aircraft can be designed and operated in a manner which will reduce the level of noise generated at the source and perceived on the ground. The introduction of the high bypass ratio engine/aircraft, and the expanded use of noise reducing materials in current and future aircraft engines are expected to reduce the severity of the aircraft noise problem. Aircraft operational alternatives can be employed to either reduce the level of noise perceived on the ground or to shift the incidence of the noise from some area to another less sensitive location. Insofar as possible, land areas affected by aircraft noise should be used for noise-compatible activities. Future airport development should take place in conjunction with land use planning for the surrounding environs. Author

**N71-33938#** Serendipity Associates, Arlington, Va. Operations Div.
**A STUDY OF THE MAGNITUDE OF TRANSPORTATION NOISE GENERATION AND POTENTIAL ABATEMENT. VOLUME 7: ABATEMENT RESPONSIBILITY Final Report**
Nov. 1970 85 p refs
(Contract DOT-OS-A9-018)
(OST-ONA-71-1-Vol-7) Avail: NTIS

Existing noise regulations and enforcement experience were analyzed for air and surface transportation at the Federal, state, and local level. The influence of the public and industrial self-regulation was also investigated. The Federal Government can regulate the noise characteristics of new aircraft and the operation of all aircraft. The specification of an acceptable airport noise environment still rests with the airport proprietor. State and local governments have adopted motor vehicle noise control regulations. New York and California have adopted numeric limits while the other states only prohibit excessive noise without specifying what it is. Federal authority exists to insure the highway noise levels will be compatible with roadside land uses: This authority will take effect on July 1, 1972 and applies only to Federally funded developments. Railroads and mass transit do not appear to pose great noise problems compared to aircraft or highways. Several regulatory actions are recommended and discussed as they pertain to the control of air and surface transportation generated noise. Author

**N71-33964#** Toronto Univ. (Ontario). Inst. for Aerospace Studies.
**SONIC BOOM ANALOGUES FOR INVESTIGATING INDOOR WAVES AND STRUCTURAL RESPONSE**
Sui Lin Nov. 1970 47 p refs Sponsored by Natl. Res. Council of Can.
(UTIAS-TN-158) Avail: NTIS

Experimental results indicate that the maximum amplitude of the indoor pressure wave induced by a sonic boom for the case of a partly open window is larger than the maximum amplitude of the incident sonic boom. In such a case, the two undesirable effects of the sonic boom are the annoyance it causes people and the effect it has upon structural members are larger indoors than outdoors. The effects of window size, room dimension, the dimensions and the properties of structural members and the shape of the sonic boom, which influence the indoor acoustical pressure and the structural dynamic response, are investigated by using an electrical analog. The method of design for the electrical analog is described. The good agreement between the results from the electrical analog and those of Vaidya shows that the electrical analog is a suitable device for investigating the sonic boom problem. Author

# 03 AUXILIARY SYSTEMS

Includes fuel cells, energy conversion cells, and solar cells; auxiliary gas turbines; hydraulic, pneumatic and electrical systems; actuators; and inverters. For related information see also: 09 Electronic Equipment; 22 Nuclear Engineering; and 28 Propulsion Systems.

**N71-32951#** Army Electronics Command, Fort Monmouth, N.J.
**CHARACTERIZATION OF THERMOELECTRIC CONVERTERS FOR USE IN HYDROCARBON FUELED POWER GENERATORS**
Guido E. Guazzoni Apr. 1971 31 p refs
(AD-724109; ECOM-3412) Avail: NTIS CSCL 10/2

A method is presented to characterize the performance capability of flame heated thermoelectric converters, relating output power, long term operation, and inherent degrading factors. Experimental verification of the method is shown through data obtained on two thermopiles from 500 watt thermoelectric generators (PP-6075( )/U). Performance parameter characterization of the two thermopiles is reported. Author (GRA)

**N71-33189#** Office National d'Etudes et de Recherches Aerospatiales, Toulouse (France). Departement d'Etudes et de Recherches en Technologie Spatiale.
**PARTIAL RESULTS ON CdS AND THIN FILM SOLAR CELLS SPATIAL RELIABILITY**
J. Bernard, J. Berry, J. P. Buisson, and A. Paillous Oct. 1970 19 p refs
(ONERA-DERTS-NT/02/29/70) Avail: NTIS

Performance tests carried out on thin film CdS and CdTe solar cells are described. They included: (1) tests operating at −40 C and 95% humidity, (2) tests performed in vacuum; the solar cells are set down in a vacuum chamber (0.000001 Torr). They are heated to 80 C during 200 hours by means of a tungsten lamp radiation. During this time the solar cells are left either in open circuit, short circuit, or connected to a load resistor allowing the maximum output; and (3) electron irradiation tests; the solar cells are irradiated under vacuum by means of different energy electrons. The plastic coatings, main cause of solar cell degradation under irradiation, are studied separately. Before and after each test each solar cell spectral response is plotted. A more exhaustive study is carried out on the CdS solar cells' photovoltaic properties. Author (ESRO)

**N71-33192#** Army Electronics Command, Fort Monmouth, N.J.
**SEALED NICKEL-CADMIUM BATTERY ASSEMBLY BB-655 ()/U, ENGINEERING EVALUATION**
E. J. Settembre Apr. 1971 30 p refs
(AD-723978; ECOM-3411) Avail: NTIS CSCL 10/3

The physical and electrical characteristics for a high energy density, sealed, nickel-cadmium battery assembly are presented. The BB-655()/U consists of twenty series connected, sealed nickel-cadmium F cells restrained in a nest between two fiberglass circuit boards and potted with rigid epoxy potting. The cell nest is housed in a lightweight, rugged, acrylonitrile-butadiene styrene (ABS) standard, manpacked battery case. This battery has the capability of furnishing 7.0 Ah at 24 volts or 14.0 Ah at 12 volts, and weighs 12.5 lbs. The battery assembly yields 13 watthours per pound and 0.7 watthours per cubic inch and meets severe electrical, environmental and mechanical tests. The environmental tests include vibration, bounce and four foot drop testing on all corners, faces and edges with a cover and with simulated equipment. This assembly is the first of the standard line ABS housed batteries required to meet these rugged environmental requirements. Author (GRA)

**N71-33238*#** Gulton Industries, Inc., Metuchen, N.J. Battery and Power Sources Div.
**PRODUCTION OF UNIFORM NICKEL-CADMIUM BATTERY PLATE MATERIALS Quarterly Report, 13 Dec. 1969 - 12 Mar. 1970**
Mar. 1970 58 p
(Contract NAS5-21045)
(NASA-CR-121424; QR-3) Avail: NTIS CSCL 10C

Sample lots of experimental sintered nickel plaques and impregnated plates were prepared in a production facility to determine the effect of process variables on plaque and plate characteristics. Sintering process variables studied were time (at 5 levels), and temperature (at 3 levels). The plaque characteristics which were examined included porosity, resistivity, and mechanical strength. The plate processing variables investigated included the degree of loading (50%, 75%, and 100% of a predetermined target value), the addition of thiourea to inhibit chemical attack on the negative plate, and a cathodic treatment of the negative plate in the caustic conversion (KOH) bath during each impregnation cycle. The plates were evaluated with respect to weight gain, ampere-hour capacity, and utilization efficiency (ratio of measured to theoretical capacity). Author

**N71-33245*** General Electric Co., Philadelphia, Pa. Space Systems Organization.
**DESIGN AND DEVELOPMENT OF A THIRTY WATT PER POUND 250 SQUARE ROLLUP SUBSOLAR ARRAY. ADDITIONAL TASKS: STOWED BLANKET DYNAMICS, IN-PLANE STRUCTURAL CHARACTERISTICS**
K. Hanson, C. Petroff, and R. Ross (JPL) 20 May 1971 147 p Sponsored by NASA Prepared for JPL
(Contract JPL-952314)
(NASA-CR-121454; DOC-71SD4239) Avail: NTIS CSCL 10A

The results of studies of the effects of wrap tension on stowed blanket dynamics and the in-plane structural characteristics of rollup solar arrays are reported. The study was based on a single boom configuration but the results are applicable to other configurations. Author

**N71-33326*#** Naval Ammunition Depot, Crane, Ind. Quality Evaluation Lab. Dept.
**EVALUATION PROGRAM FOR SECONDARY SPACECRAFT CELLS: SYNCHRONOUS ORBIT TESTING OF GENERAL ELECTRIC COMPANY 12.0 AMPERE-HOUR NICKEL-CADMIUM CELLS**
D. E. Christy 10 Jun. 1971 62 p refs
(NASA Order W-12397)
(NASA-CR-121450; QE/C-71-183) Avail: NTIS CSCL 10A

Performance information concerning sealed nickel cadmium cells, with auxillary electrodes, operating under a synchronous orbit regime was reported. It was found that a 0 C operating temperature gave the best results with cells operating at 20 C running a close second in capacity and overall performance. The auxiliary electrodes showed a tendency to become desensitized to the oxygen produced during charge. It was found that, for equal temperature regimes, the greater depths of discharge were the most detrimental to the capacity. J.G.M.

**N71-33409*** National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
**SOLAR CELL Patent**
Elmer R. Streed, inventor (to NASA) Issued 6 Jul. 1971 5 p Filed 6 Feb. 1969
(NASA-Case-ARC-10050; US-Patent-3,591,420; US-Patent-Appl-SN-797219; US-Patent-Class-136-89) Avail: US Patent Office CSCL 10A

A solar cell which utilizes phosphors in the cover glass which are excited to fluorescence by solar ultraviolet radiation

and particulate radiation is described. The fluorescent energy passes through the interference filter for utilization in the solar cell, while the ultraviolet and other radiation would not normally be converted to electrical energy because the wavelength is not within the spectral response limits of the solar cell. Author

**N71-33412*#** Massachusetts Inst. of Tech., Cambridge. Physics of Solids Lab.

**THERMOELECTRICITY IN MAGNETIC ALLOYS Final Technical Report**

D. J. Sellmyer and J. Zagarins Nov. 1970 35 p refs

(Contract NAS12-2040)

(NASA-CR-121384) Avail: NTIS CSCL 10A

Mechanisms leading to giant Seebeck coefficients in metallic alloys were studied. Experimental measurements were made in Fe doped AgPd alloys between 4.2 and 520 K. The resistance minimum phenomenon (Kondo effect) and giant thermopower was discovered in Ag(Fe) alloys and estimates of the Kondo temperature and exchange scattering parameter are 15 K and −0.53 eV, respectively. The AgPd (Fe) alloys show large negative thermopowers (approximately −40 microvolts deg) in the region above room temperature. The experimental results in conjunction with recent theories of thermoelectricity in the presence of s-d scattering suggest that the exchange parameter remains negative (antiferromagnetic) for all values of x between 0 and 1. This result contradicts the interpretation recently given to Kondo effect behavior in CuPd (Fe) alloys in which a change in sign of the exchange parameter was suggested. Author

**N71-33695*#** Electronic Communications, Inc., St. Petersburg, Fla.

**MICROELECTRONIC POWER SUPPLIES Final Report**

May 1971 48 p

(Contract NAS8-24817)

(NASA-CR-119918; SIER-71-0194) Avail: NTIS CSCL 09E

A series of miniature power supplies designed for operation in aerospace applications where small size and weight and high efficiency are of primary concern are described. Two basic types of circuits have been developed; main supplies and remote regulators. The main power supply interfaces with the spacecraft 28 volt power source and provides output voltages which are transformer isolated via a dc-dc converter from the primary 28-volt lines. Reverse polarity protection and EMI filtering are included. Each main supply delivers up to three watts to a group of remote regulators. The remote regulators are thick film hybrid circuits suitable for providing on-card regulation for integrated circuits. Four types of remote regulators have been developed which provide output voltages of +5, +15, −15, −5.2 and −27 volts. Nominal efficiency at full load for both the main supplies and the remote regulators are in the 80 to 85 percent range. Author

**N71-33678*#** Eagle-Picher Co., Joplin, Mo. Electronics Div.

**STUDY OF PROCESS VARIABLES ASSOCIATED WITH MANUFACTURING HERMETICALLY SEALED NICKEL-CADMIUM CELLS Quarterly Report, 23 May−23 Aug. 1970**

William C. Harsch, Donald J. Doan, and Earl S. Carr Dec. 1970 45 p refs

(Contract NAS5-21159)

(NASA-CR-121470; QR-2) Avail: NTIS CSCL 10C

Experiments designed to determine the critical process variables in the manufacturing of aerospace nickel-cadmium cells were reported. Analyses of plaque sintering experimental data, setting up of the impregnation and polarization process for cell plates, and a study of separator materials and ceramic-to-metal seals were described. Variance analysis of the plaque manufacturing data showed that 85% of the total variation occurs within any individual plaque. It was further concluded that a 2% variation is introduced into the plaque by virtue of the manufacturing process. Regression equations were determined with and without interactions. The results were compared and it was determined that there are significant interactions for this manufacturing process. Use was made of the regression equation to predict variability of the plaque manufacturing process within the normal tolerance range of the equipment. Author

**N71-33685*#** Ion Physics Corp., Burlington, Mass.

**SOLAR CELL COVER GLASS DEVELOPMENT Final Report**

A. R. Kirkpatrick, F. T. C. Bartels, and G. A. Tripoli Mar. 1971 44 p refs

(Contract NAS5-10238)

(NASA-CR-121468) Avail: NTIS CSCL 10C

The development of a practical integral coverslip technology for solar cell utilization is described. The course of the integral coverslipping technique using high vacuum ion beam sputtering is summarized. Author

**N71-33692*#** Electric Storage Battery Co., Raleigh, N.C. Exide Missile and Electronics Div.

**HEAT STERILIZABLE, IMPACT RESISTANT CELL DEVELOPMENT Quarterly Reports**

Apr. 1971 22 p Prepared for JPL

(Contracts NAS7-100; JPL-951296)

(NASA-CR-121455) Avail: NTIS CSCL 10C

Sixty sealed Ag-ZnO cells with 20 A-h rated capacities were designed, fabricated, and cycle tested. The effects of two cycling regimes; two polypropylene absorbers; positive, negative, and spiral wrapping; wedge shaped vs standard negatives; and extended vs standard negatives on cell cycle life were examined. Author

**N71-33790*#** Hittman Associates, Inc., Columbia, Md.

**RADIATION FLUX MAPPING OF OPE SPACECRAFT MODELS, PHASE 3**

Aug. 1970 25 p refs

(Contract NAS5-11225)

(NASA-CR-121441; HIT-472) Avail: NTIS CSCL 10C

Analytical techniques and application of these techniques in evaluating the primary and scattered RTG radiations with respect to selected OPE spacecraft models are discussed. In addition, an optimization scheme for the purpose of analyzing minimum weight shields is developed. The overall effort consists of three phases: (1) the conversion of FASTER to the IBM 360/95 configuration and the preparation of pertinent nuclear data for the OPE spacecraft shielding studies, (2) the detailed flux mapping of a pair of RTG's and representative RTG-spacecraft configurations, and (3) the development of an optimization code for minimum weight shield analysis. This report summarizes the results of the third phase. Author

**N71-33824*#** Union Carbide Corp., Parma, Ohio. Consumer Products Div.

**SECONDARY ZINC-OXYGEN CELL FOR SPACECRAFT APPLICATIONS Final Report, 23 Jun. 1966−1 Sep. 1968**

Apr. 1971 184 p refs

(Contract NAS5-10247)

(NASA-CR-121479) Avail: NTIS CSCL 10C

The zinc-oxygen system was found to be capable of producing up to 350 discharge-charge cycles above the 1.0 volt end-point at 25 C on the 2-hour discharge/2-hour charge regime at a discharge current density of 11-12 mA/sq cm. Unit cell performance was further determined at various current densities over the temperature range of 0 to 40 C. Test cycle regimes included the 2-hour discharge/2-hour charge; 2-hour discharge/4-hour charge;

2-hour discharge/22-hour charge; 2-hour discharge/4-hour and the 24-hour discharge/24-hour charge. Cycle life was limited by configurational changes in the anode and in some instances by the oxygen electrode. Author

N71-33828*# Florida Univ., Gainesville. Coll. of Engineering.
**A STUDY OF GAS SOLUBILITIES AND TRANSPORT PROPERTIES IN FUEL CELL ELECTROLYTES Semiannual Report, 1 Mar. – 31 Aug. 1970**
R. D. Walker, Jr. 30 Oct. 1970 138 p refs
(Grant NGL-10-005-002)
(NASA-CR-121432; SAR-10) Avail: NTIS CSCL 10C

Theoretical studies of solubility of gases in electrolytes, based on the Percus-Yevick theory, have been made. The theory predicts accurately the solubility and activity coefficients for both the salting-in and the salting-out systems. Several problems were solved in the measurement of partial molal volume of gases in electrolytes. Improvements on the theory for partial-molal volume were made, and comparison with experimental data shows favorable results. Diffusion coefficients of oxygen in lithium hydroxide were measured using the dropping mercury electrode method for temperatures up to 60 C. In the case of the theoretical studies, a hard sphere kinetic theory has been developed. This theory gives fair prediction on the diffusion coefficients of gases in electrolytes. An extensive literature survey was made on the physical properties of the ternary system $K_2CO_3$ – KOH – $H_2O$. Experimental measurements of the vapor pressure using the isopiestic method were performed and the feasibility of using an empirical mixing rule was also investigated. Author

# 04 BIOSCIENCES

Includes aerospace medicine, exobiology, radiation effects on biological systems; physiological and psychological factors. For related information see also: 05 Biotechnology.

N71-32863# Istituto di Fisica dell'Atmosfera, Rome (Italy).
**ATMOSPHERIC STABILITY AND AEROSOL POLLUTION. PROPOSAL OF A SIMPLE METHOD FOR EVALUATING THE CONDITIONS OF AIR STABILITY**
Luigi Mammarella Jan. 1971 11 p
(IFA-RDP-36) Avail: NTIS

The interaction of atmospheric temperature, humidity, air motion, and temperature inversions, in connection with the transport of aerosol pollutants, are investigated, and a method is proposed to ascertain atmospheric stability. ESRO

N71-32907# Naval Air Development Center, Johnsville, Pa. Aerospace Crew Equipment Dept.
**PHYSIOLOGICAL EVALUATION OF SUBJECTS EXPOSED TO A COLD WATER ENVIRONMENT WHILE WEARING DIFFERENT PROTECTIVE SUIT ASSEMBLIES Interim Report**
Louis J. Santa Maria and Meredith H. Radliff 15 Mar. 1971 29 p refs
(AD-724617; NADC-AC-7101) Avail: NTIS CSCL 6/17

The physiological responses of two volunteer subjects exposed to an extreme cold water environment (0C) while wearing the 3/16 inch Chloroprene Wet Suit, 1/8 inch Chloroprene Wet Suit, and the Polyvinyl Chloride Wet Suit were investigated under two conditions of use: constant immersion-flotation (COND I) and immersion-flotation for a two-minute period followed by raft occupancy (COND II). In view of exposure duration ranging from 0.5-1.0 hr and from 2.0-3.0 hr under CONDITIONS I and II, respectively, the results indicate that survival and tissue damage protection is afforded, within expected limits of time under both emergency conditions for search and recovery, by any of the clothing assemblies tested. It is recommended, therefore, that the 1/8 inch Chloroprene Wet Suit be considered as the most acceptable on the basis of such physical characteristics as reduced weight and bulk. Author (GRA)

N71-32968# Istituto Superiore di Sanita, Rome (Italy). Lab. di Fisica.
**PROCEDURE MANUAL FOR THE DEPARTMENT OF ELECTRON MICROSCOPY. 2: PREPARATION OF EMBEDDED BIOLOGICAL SPECIMENS [RICETTARIO AD USO DEL REPARTO DI MICROSCOPIA ELETTRONICA. 2: ALLESTIMENTO DEI PREPARATI INCLUSI]**
23 Mar. 1970 77 p refs In ITALIAN; ENGLISH summary
(ISS-70/8) Avail: NTIS

Chemical, physical and biological procedures employed in the department of electron microscopy are reported. The isolation procedure of the biological material and the fixation, dehydration and embedding methods are described. Author

N71-33221*# Exotech, Inc., Washington, D.C.
**PLANNING, EVALUATION AND ANALYTICAL STUDIES TO IMPLEMENT PLANETARY QUARANTINE REQUIREMENTS Quarterly Progress Report**
Edward J. Bacon Aug. 1971 48 p
(Contract NASw-2062)
(NASA-CR-121423; QPR-5) Avail: NTIS CSCL 06M

Activities are summarized in support of the evaluation of planetary quarantine requirements, the quarantine document system for planetary flights, microbial contamination logs for Venus and Mars, evaluation of flight project quarantine plans, supporting technology transfer, specification of the probability of microbial transfer, estimation of the encapsulated microbial burden, and supporting analysis of planetary quarantine and sterilization parameters. Presentations are appended including an analysis of microbial release probabilities; an estimation of buried microbial burden; and safety margins and implementation of planetary quarantine requirements. J.M.

N71-33223*# Wisconsin Univ., Madison. Dept. of Radiology.
**SKELETAL STATUS AND SOFT TISSUE COMPOSITION OF ASTRONAUTS. DETERMINATION OF BODY COMPOSITION IN VIVO Progress Report, 15 Jun. 1970 – 15 Jun. 1971**
John R. Cameron 15 Jun. 1971 177 p refs
(Grant NGR-50-002-051; Contract AT(11-1)-1422)
(NASA-CR-121415) Avail: NTIS CSCL 06P

A summary is presented of research and instrument development in the area of bone mineral content and body composition measurement in vivo. Author

N71-33232*# California Univ., Berkeley. Space Sciences Lab.
**ENZYME ACTIVITY IN TERRESTRIAL SOIL IN RELATION TO EXPLORATION OF THE MARTIAN SURFACE Semiannual Progress Report**
A. D. McLaren, W. H. Brams, R. G. Burns, and A. H. Pukite 1 Jul. 1971 39 p refs *Its* Ser. 12, Issue 57
(Grant NGL-05-003-079)
(NASA-CR-121446; SAPR-14) Avail: NTIS CSCL 06M

Enzyme activities in soil are explored including abundance, persistence, and localization of these activities, in an attempt to develop procedures for detection and assay of enzymes in soils suitable for life in planetary soils. A sensitive test for soil urease was made based on hydrolysis of heat-stable C-14 urea and the

urease activity of ancient and buried soils is described. A mathematical model was developed, based on enzyme action and microbial growth in soil, for rates of oxidation of nitrogen as nitrogen compounds are moved downward by water flow. This biogeochemical model is applicable to any percolating system, with suitable modification for special features, such as oxygen concentrations, types of hydrodynamic flow, etc. A suitable extraction procedure for soil enzymes is reported, and measuring activities in one such extract are detailed in order to study how urease is complexed in soil organic matter. Nearly 30 percent of soil enzymes can be isolated as colloidal, clay-free suspensions. Author

**N71-33251*#** National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
**HYPOGRAVIC AND HYPODYNAMIC ENVIRONMENTS**
Raymond H. Murray and Michael McCally, eds. Washington 1971 380 p refs Conf. held at French Lick, Ind., 16-18 Jul. 1969; Sponsored in part by Armour Pharm. Co., Lederle Labs., Merck, Sharp, and Dohme, and Sandoz Pharm.
(NASA-SP-269; A-3652) Avail: NTIS HC $6.00/MF $0.95 CSCL 06P

Papers and discussions are presented dealing with hypodynamic and hypogravic aspects of the space flight environment, particularly inactivity, confinement, and weightlessness. For individual papers, see: N71-33252 through N71-33275.

**N71-33252*#** National Aeronautics and Space Administration. Manned Spacecraft Center, Houston, Tex.
**SPACEFLIGHT DECONDITIONING: AN OVERVIEW OF MANNED SPACEFLIGHT RESULTS**
Lawrence F. Dietlein *In its* Hypogravic and Hypodyn. Environments 1971 p 1-26 refs (See N71-33251 20-04)
Avail: NTIS HC $6.00/MF $0.95 CSCL 06P

Physiological changes observed in astronauts during manned space flights are reviewed. Results of studies indicate that major physiological systems undergo consistent and predictable changes as a result of space flight. Changes were observed in the cardiovascular and musculoskeletal systems; composition and quantity of body fluids, including the blood; and in certain hormone and blood cell levels. Results derived from Mercury, Gemini, and Apollo flights through Apollo 10 are summarized. A.L.

**N71-33253*#** National Aeronautics and Space Administration. Manned Spacecraft Center, Houston, Tex.
**HEMATOLOGIC IMPLICATIONS OF HYPODYNAMIC STATES**
Craig L. Fischer, Carolyn Leach, and Philip C. Johnson (Baylor Coll. of Med.) *In its* Hypogravic and Hypodyn. Environments 1971 p 27-34 refs (See N71-33251 20-04)
Avail: NTIS HC $6.00/MF $0.95 CSCL 06P

The red cell mass and plasma volume changes noted in the hypodynamic states of bed rest and water immersion are reviewed, and these changes are compared with the hypodynamic and hypogravic state characteristics of earth orbital missions. Author

**N71-33254*#** Texas Womens Univ. Research Inst., Denton, Tex.
**BONE DENSITY CHANGES IN THE ASTRONAUTS DURING SPACEFLIGHT**
Pauline Berry Mack *In* NASA. Ames Res. Center Hypogravic and Hypodyn. Environments 1971 p 35-50 refs (See N71-33251 20-04)
Avail: NTIS HC $6.00/MF $0.95 CSCL 06S

The astronaut bone density studies described were designed to determine: (1) the extent of bone density loss experienced during spaceflight; (2) possible means of reducing such losses; and (3) the rate of postflight recovery of any bone mineral loss. Author

**N71-33255*#** National Institutes of Health, Bethesda, Md.
**METABOLIC STUDIES OF THE GEMINI 7 14-DAY ORBITAL SPACEFLIGHT**
G. Donald Whedon and Leo Lutwak (Cornell Univ., Ithaca) *In* NASA. Ames Res. Center Hypogravic and Hypodyn. Environments 1971 p 51-84 refs (See N71-33251 20-04)
Avail: NTIS HC $6.00/MF $0.95 CSCL 06S

Described is the effort undertaken to perform complete metabolic balance studies of two astronauts during a 10-day preflight control phase, 14 days of orbital spaceflight (NASA Gemini 7), and a 4-day postflight recovery phase. The studies included measurement of dietary intakes and excretions of calcium, magnesium, phosphate, sulfate, nitrogen, sodium, potassium, and chloride; urinary excretions of 17-hydroxycorticosteroids, aldosterone, and catecholamines were also measured. This study was planned within the rigorous constraints of the technical characteristics of the flight itself. These characteristics included astronaut training, geographic and temporal aspects of the flight plan and schedule, and the limited volume of the space vehicle. In addition, the medical observations, including certain hematologic and cardiovascular measurements, as well as the metabolic study, were but a part of the total effort, including extensive operational and physics-oriented experimental activities required of the astronauts before, during, and after the flight. Author

**N71-33256*#** Leeds Univ. (England).
**ASSESSMENT OF BONE MASS IN RELATION TO INACTIVITY**
B. E. Christopher Nordin, A. Horsman, and L. Bulusu *In* NASA. Ames Res. Center Hypogravic and Hypodyn. Environments 1971 p 85-98 refs (See N71-33251 20-04)
Avail: NTIS HC $6.00/MF $0.95 CSCL 06S

Existing techniques for the measurement of changes in bone mass due to immobilization are reviewed. The techniques are morphometry, X-ray densitometry, gamma ray densitometry, and neutron activation. Also examined was measurement of calcium loss in urine. Results of the study indicate that no densitometric procedure is likely to be as sensitive in detecting the onset of osteoporosis as the chemical measurement of the loss of bone mineral in the excreta. Although full metabolic balances with turnover studies represent the ideal way of observing the metabolic changes, the measurement of the rate of calcium excretion in the fasting state could be a valuable substitute under space flight conditions. A.L.

**N71-33257*#** Wisconsin Univ., Madison. Medical Center.
**SOME PHYSICAL METHODS OF SKELETAL EVALUATION**
John R. Cameron, John M. Jurist, and Richard B. Mazess *In* NASA. Ames Res. Center Hypogravic and Hypodyn. Environments 1971 p 99-110 refs (See N71-33251 20-04)
Avail: NTIS HC $6.00/MF $0.95 CSCL 06S

Changes in the musculoskeletal system occur in hypodynamic and hypogravic conditions; these changes, which occur in both bed bound patients and astronauts, may lead to medical problems. Some of the major changes are summarized, and newer physical methods useful in their measurement reviewed. Author

**N71-33258*#** Mayo Clinic, Rochester, Minn.
**BONE AT THE CELLULAR LEVEL: THE EFFECTS OF INACTIVITY**
Jenifer Jowsey *In* NASA. Ames Res. Center Hypogravic and Hypodyn. Environments 1971 p 111-120 refs (See N71-33251 20-04)

(Grant AM-8658)
Avail: NTIS HC $6.00/MF $0.95 CSCL 06S

Various degrees of inactivity result in loss of bone known as osteopenia, ranging from severe, almost complete immobilization or paralysis, where severe osteopenia is the rule, to more subtle bone loss, reported as a result of lack of gravitational force imposed on astronauts. Several questions are considered that have arisen from the relatively few studies conducted to date. These are: (1) What is the mechanism of bone loss development? (2) Is increased resorption a feature of immobilization? (3) What is the physiologic mechanism of bone loss? (4) What factors will prevent the development of disuse osteopenia? Author

N71-33259*# Harvard Univ., Boston, Mass. School of Medicine.
**ESTIMATION OF TOTAL SKELETAL MASS IN MAN BY RADIOISOTOPE DILUTION**
Robert M. Zollinger, Jr. (Peter Bent Brigham Hosp.) and Francis D. Moore *In* NASA. Ames Res. Center Hypogravic and Hypodyn. Environments 1971 p 121–128 refs Sponsored in part by AEC, NIH, Army Med. Res. and Develop. Command and John A. Hartford Found., Inc. (See N71-33251 20-04)
Avail: NTIS HC $6.00/MF $0.95 CSCL 06P

An attempt to predict skeletal weight using the compositional terms of exchangeable potassium (K sub e) and fat free solids (FFS) was made from the observed values in isotope studies and calculated values obtained from regressions based on weight, sex, and age. The predicted values were then combined with data developed by Allen, and an equation devised that related skeletal size to K sub e and the K sub e/FFS ratio. Derivation of the equation and the supporting body composition regressions to predict the compositional values needed are outlined. Additional data, from a patient with antemortem isotope dilution studies and postmortem skeletal dissection with chemical analysis, are presented for both the verification of this technique and for discussion of actual measurements of skeletal size in man. Author

N71-33260*# Aerospace Medical Research Labs., Wright-Patterson AFB, Ohio.
**DISUSE ATROPHY IN MACACA MULATTA AND ITS IMPLICATIONS FOR EXTENDED SPACE FLIGHT**
Leon E. Kazarin and Henning E. von Gierke *In* NASA. Ames Res. Center Hypogravic and Hypodyn. Environments 1971 p 129–144 refs (See N71-33251 20-04)
Avail: NTIS HC $6.00/MF $0.95 CSCL 06S

In order to study the mechanisms operative in producing changes in bone structure, the time constants involved, the reversibility of these effects, and corrective measures to counteract these adverse effects, a program was initiated to investigate the response of the Rhesus monkey to prolonged plaster of paris immobilization. Changes in bone structure as well as quantitative changes of bone strength in situ were observed. As a means of evaluating the practical and operational significance of these changes, some of the primates were exposed after immobilization to impact loads for which injury probability for normal controls was known. The monkeys were restrained in a zoometrically designed seat and exposed to longitudinal transient acceleration in experiments designed to produce vertebral fracture of the type seen in man during longitudinal spinal impact. Some of these immobilized and impacted animals were allowed to recover for 7 months under normal conditions so that delayed manifestations of the impact trauma and recovery could be observed. The basic structural changes of bone and changes in spinal impact tolerance resulting from prolonged immobilization are summarized. Author

N71-33261*# Georgetown Univ. Hospital, Washington, D.C.
**NONDESTRUCTIVE MEASUREMENT OF SOME PHYSICAL PROPERTIES OF BONE**
W. F. Abendschein and G. W. Hyatt *In* NASA. Ames Res. Center Hypogravic and Hypodyn. Environments 1971 p 145–170 refs (See N71-33251 20-04)
Avail: NTIS HC $6.00/MF $0.95 CSCL 06P

Investigations have emphasized the development of nondestructive methods for precise determination of the functional characteristics of bone. These include such physical properties as density, breaking strength, and modulus of elasticity. Tests were performed on normal and pathologic specimens of human tibial cortial bone to develop and document the relationship of destructive and nondestructive testing, and to investigate the correlation, ultrasonic velocity measurements, mass density measurements, and mechanical loading. A.L.

N71-33262*# Texas Univ., Dallas. Southwestern Medical School.
**EFFECTS OF BED REST ON THE OXYGEN TRANSPORT SYSTEM**
Gunnar Blomquist, Jere H. Mitchell, and Bengt Saltin *In* NASA. Ames Res. Center Hypogravic and Hypodyn. Environments 1971 p 171–186 refs (See N71-33251 20-04)
(Grant HE-06296)
Avail: NTIS HC $6.00/MF $0.95 CSCL 06S

Current data on circulatory effects of bed rest are discussed against the background of a recent laboratory study dealing with adaptive changes in oxygen transport and body composition after bed rest and after training. In this investigation, maximal oxygen uptake was used as the index of maximal cardiovascular function. Five 19 to 21 year old college students were selected for the study. The investigation was divided into three phases: (1) a short control period; (2) a 3-week bed rest period; and (3) a 2-month physical training period. Identical sets of studies were performed at the end of each period. Results of the three phases are discussed and presented tabularly and graphically. A.L.

N71-33263*# Public Health Service Hospital, San Francisco, Calif.
**HEMODYNAMIC AND BODY FLUID ALTERATIONS INDUCED BY BEDREST**
Kenneth H. Hyatt *In* NASA. Ames Res. Center Hypogravic and Hypodyn. Environments 1971 p 187–210 refs (See N71-33251 20-04)
Avail: NTIS HC $6.00/MF $0.95 CSCL 06S

Studies were undertaken to develop an understanding of deadaptation physiology. In these studies, all subjects were healthy male volunteers, aged 21-35. There have been three types of studies: 10-day, 14-day, and 28-day bed rest. In all cases subjects were carefully screened to exclude disease, and were subjected to a noninstrumented 70 deg foot-down passive tilt prior to entry into the study to exclude those with autonomic insufficiency. Statistical analysis was performed by a paired Student's test. Results of the 14-day and 28-day studies are presented. The results of the 10-day bed rest study have been previously reported by NASA. A.L.

N71-33264*# Aerospace Medical Research Labs., Wright-Patterson AFB, Ohio.
**EFFECTS OF BED REST ON FOREARM VASCULAR RESPONSES TO TYRAMINE AND NOREPINEPHRINE**
Philip G. Schmid, Michael McCally, Thomas E. Piemme, and James A. Shaver *In* NASA. Ames Res. Center Hypogravic and Hypodyn. Environments 1971 p 211–224 refs (See N71-33251 20-04)
Avail: NTIS HC $6.00/MF $0.95 CSCL 06S

To test for disturbances in the peripheral adrenergic nerve function, observations were made of forearm vascular responses to brachial artery infusions of tyramine and norepinephrine after two weeks of bed rest and after control periods of normal vigorous daily activity. The study was subdivided into three periods. An initial control period consisted of 8 days of unrestricted activity. The second period consisted of 12 days of bed rest. The third, or recovery period, consisted of 6 more days of activity and began when the subjects got out of bed. Experiments were conducted on

the last day of each period and care was taken to conduct separate sessions under the same conditions. The test periods are discussed and results are presented of the basal values measured before and during infusions of the drugs. Measurements of total catecholamines in the urine are also presented. A.L.

N71-33265*# School of Aerospace Medicine, Brooks AFB, Tex.
**THE EFFECT OF TOTAL BODY EXERCISE ON THE METABOLIC, HEMATOLOGIC, AND CARDIOVASCULAR CONSEQUENCES OF PROLONGED BED REST**
Malcolm C. Lancaster and John H. Triebwasser *In* NASA. Ames Res. Center Hypogravic and Hypodyn. Environments 1971 p 225–248 refs (See N71-33251 20-04)
Avail: NTIS HC $6.00/MF $0.95 CSCL 06S

The first phase of a study of exercise effects in the prevention of the physiological changes induced by prolonged bed rest has been completed. Because all analyses have not been completed, metabolic and certain special assays, such as renin, renin substrate, and ADH, are not reported. Also, some of the hematologic data have not been evaluated. Eight male subjects participated in the experiment which covered a period of 16 weeks: 5 weeks of control, 5 weeks of bed rest, and 6 weeks of recovery. All exercise was performed on a special total body ergometer that simulates zero gravity while permitting exercise under conditions of normal stress to the fully ambulatory musculoskeletal system. Results are presented of orthostatic stress tests, psychomotor tests, work tolerance, and psychobiologic studies. A.L.

N71-33266*# Public Health Service Hospital, San Francisco, Calif.
**THE EFFECTS OF LONG-TERM BED REST ON MINERAL METABOLISM**
Charles L. Donaldson, Donald E. McMillan, Stephen B. Hulley, Robert S. Hattner, and Jon H. Bayers *In* NASA. Ames Res. Center Hypogravic and Hypodyn. Environments 1971 p 249–260 refs (See N71-33251 20-04)
(NASA Order T-58941; NASA Order T-81070)
Avail: NTIS HC $6.00/MF $0.95 CSCL 06S

This study was initiated to determine the effect of long term bed rest on mineral balance and bone density in normal individuals. Three healthy male volunteers were studied during 4 weeks of ambulation, 30 to 36 weeks at rest in bed, and another 4 weeks of ambulation after bed rest. They were maintained on a diet of 2100 calories with 908 mg calcium and 1386 mg phosphorus throughout ambulation and bed rest. Calcium and magnesium in serum, urine, sweat, stool, and diet were determined by atomic absorption spectrophotometry. Standard autoanalyzer methods were used for measuring phosphorus. A second phase of the study, comparing the effectiveness of exercise with that of phosphate in modifying the changes of bed rest, showed that isometric and isotonic exercise has not proved effective in preventing the negative mineral balance induced by bed rest. Results indicated that nine months of horizontal bed rest caused distinct os calcis dimineralization in three healthy young men, accompanied by a negative calcium balance that persisted until reambulation. Measures designed to prevent these changes of calcium balance and bone are under investigation. A.L.

N71-33267*# Public Health Service Hospital, San Francisco, Calif.
**CHANGES IN BONE MINERAL CONTENT OF THE OS CALCIS INDUCED BY PROLONGED BED REST**
John M. Vogel *In* NASA. Ames Res. Center Hypogravic and Hypodyn. Environments 1971 p 261–270 refs (See N71-33251 20-04)
(NASA Order T-58941; NASA Order T-80173)
Avail: NTIS HC $6.00/MF $0.95 CSCL 06S

The effects of prolonged bed rest on bone and calcium metabolism and methods that might effectively alter the mineral loss known to result from bed rest were investigated. Three subjects in their twenties were selected to undergo a 9 month period of bed rest. They were maintained on a rigidly controlled metabolic diet that contained 910 mg calcium per day. Gamma ray densitometry was performed at regular intervals from months 3 to 9 of bed rest and for 5, 7, and 8 months after reambulation. This study demonstrated that there is a significant loss of mineral content of the os calcis during 9 months of bed rest. There is a rapid regain after ambulation, which does not reach prebed rest values until 4 to 6 months have elapsed. It was concluded that prolonged periods of bed rest, and therefore zero gravity conditions, can materially reduce the mineral content of the os calcis and place this bone at risk when ambulation or gravity conditions are reinstituted. A.L.

N71-33268*# Case Western Reserve Univ., Cleveland, Ohio.
**THE RELATIONSHIP BETWEEN THE DIURNAL AND MEAL-DRIVEN RHYTHMS OF KIDNEY FUNCTIONS IN SUBJECTS AT REST**
Olgard Lindan *In* NASA. Ames Res. Center Hypogravic and Hypodyn. Environments 1971 p 271–280 refs (See N71-33251 20-04)
(Grant HED-RD-1144-M)
Avail: NTIS HC $6.00/MF $0.95 CSCL 06S

In order to study the relationship between diurnal and meal driven excretory patterns in the human kidney, and the possible effect on the kidney of the removal of the diurnal clock, study subjects with normal controls and patients paralyzed with high spinal cord injury were studied while confined to bed. The test schedules lasted from 14 to 21 days and the total average food intake was identical for each subject. The drinking was given either with meals or independently at random. In this study, the diurnal kidney cycle was dwarfed with meal cycles by having the subject consume large meals at regular frequencies, uncorrelated with the day/night cycle. It was not surprising that the results indicated that the kidney should be governed tightly in its activities by the intake of food, however, it was puzzling that certain of its homeostatic mechanisms should apparently follow a day/night cycle. The primary triggering mechanism and the purpose of the diurnal cycle for electrolyte excretion is unknown. A.L.

N71-33269*# Pittsburgh Univ., Pa.
**EFFECTS OF TWO WEEKS OF BED REST ON CARBOHYDRATE METABOLISM**
Thomas E. Piemme *In* NASA. Ames Res. Center Hypogravic and Hypodyn. Environments 1971 p 281–288 refs (See N71-33251 20-04)
Avail: NTIS HC $6.00/MF $0.95 CSCL 06S

In view of the apparent inefficient handling of glucose during bed rest and inactivity, a carefully controlled study was conducted to investigate the nature of the carbohydrate intolerance observed during bed rest and some of the factors that might produce such intolerance. Seven health subjects were placed under strict dietary control and supervised activity for a period of four weeks. The first and fourth weeks served as control and recovery periods, respectively, and the second and third weeks comprised the period of enforced bed rest. All subjects showed an elevated peak glucose level and an increased area under the 4-hr glucose curve during the bed rest period as compared with the control period. Insulin responses to glucose administration were markedly augmented during the bed rest cycle. Insulin response to each of three different stimuli was augmented during bed rest in all subjects. Results appear to indicate that there is a relative ineffectiveness of insulin in lowering blood glucose levels during recumbency. A.L.

N71-33270*# School of Aerospace Medicine, Brooks AFB, Tex.
**THE EFFECT OF BED REST ON GLUCOSE REGULATION IN MAN: STUDIES IN PROGRESS**

Frank R. Lecocq *In* NASA. Ames Res. Center Hypogravic and Hypodyn. Environments 1971 p 289–298 refs (See N71-33251 20-04)
Avail: NTIS HC $6.00/MF $0.95 CSCL 06S

Data are presented from two bed rest studies in which isolated parameters of glucose balance during bed rest were investigated. In one study, forearm glucose uptake during glucose loading was measured; in the other study, the effect of an intracellular hypoglycemic agent (2 deoxy-D-glucose) on glucoregulatory hormones was examined. The forearm glucose uptake study was designed to determine the quantitative significance of peripheral glucose uptake in subjects maintained at bed rest for 14 days. Infusion of 2 deoxy-D-glucose before, during, and after 14 days of bed rest was designed to confirm and amplify previous observations that the hypodynamic condition imposed by bed rest decreases pituitary growth hormone responsiveness. Test results showed that significant alterations in both peripheral glucose utilization during glucose loading and glucoregulatory hormone response to intercellular glucopenia are induced by simple absolute bed rest. Whether these changes represent a homeostatic adaption to bed rest or have pathophysiological significance could not be concluded from these data. However, these findings have significance for both clinical medicine and for the assessment of human response to the effects of prolonged space flight. A.L.

**N71-33271*#** School of Aerospace Medicine, Brooks AFB, Tex.
**HEMATOLOGIC ASPECTS OF BED REST**
Malcolm C. Lancaster *In* NASA. Ames Res. Center Hypogravic and Hypodyn. Environments 1971 p 299–322 refs (See N71-33251 20-04)
Avail: NTIS HC $6.00/MF $0.95 CSCL 06S

Results are presented of studies in which the red cell mass (RCM) loss that occurs with bed rest was documented by means of direct red cell label. Twenty-one healthy males participated in the experiment which consisted of a 20-day adjustment phase, 35 days of continuous absolute bed rest, and a 20-day recovery phase. Eight additional males were used to control such variables as age, blood lettings, seasonal changes, and stability of red cell and plasma volumes. The RCM decreased during bed rest in 18 of the 21 subjects with an average loss of 140 ml representing approximately 8 percent of the RCM. Plasma volumes determined by indirect estimation of RCM and corrected microhematocrit decreased some 400 ml during bed rest, and plasma volumes determined at the end of the recovery by a direct method showed values well above those obtained prior to bed rest. Stool tests for occult blood were consistently negative. The results reported agree with the previously described plasma volume changes that occurred during bed rest, where plasma volume was determined by either T-1824 or radioiodinated serum albumin, and the RCM was determined indirectly. A.L.

**N71-33272*#** Aerospace Medical Research Labs., Wright-Patterson AFB, Ohio.
**IMMERSION TECHNIQUES AND THE EVALUATION OF SPACEFLIGHT DECONDITIONING COUNTERMEASURES**
Michael McCally and Charles C. Wunder (Iowa State Univ. of Sci. and Technol., Ames) *In* NASA. Ames Res. Center Hypogravic and Hypodyn. Environments 1971 p 323–344 refs (See N71-33251 20-04)
Avail: NTIS HC $6.00/MF $0.95 CSCL 06S

The physiological effects of water immersion in simulating weightlessness are reviewed. Discussed are: (1) cardiovascular effects; (2) body fluid volumes; (3) renal effects; (4) lung volumes; (5) intrapulmonary pressure and pressure-volume relationships; (6) role of transpharyngeal pressure gradient; (7) temperature effects; and (8) space crew performance. Also presented are the results of a study designed to test the relative effectiveness of six different countermeasures for deconditioning: venous occlusive cuffs; an elastic gradient counterpressure garment or leotard; exposure to lower body negative pressure; ADH administration; positive pressure breathing at 15 mm Hg; and mild cold exposure. A.L.

**N71-33273*#** Frie Univ., Berlin (West Germany).
**BODY FLUID REGULATION DURING IMMERSION**
Otto H. Gauer *In* NASA. Ames Res. Center Hypogravic and Hypodyn. Environments 1971 p 345–356 refs (See N71-33251 20-04)
(Contract F61052-68-C-0069)
Avail: NTIS HC $6.00/MF $0.95 CSCL 06S

The effects of posture on body fluid circulation; blood volume control and weightlessness; and the effects of water immersion on renal function, plasma volume, distribution of extracellular fluid volume, venous tone, and physical working capacity are discussed. A.L.

**N71-33274*#** Webb Associates, Yellow Springs, Ohio.
**DECONDITIONING AND ITS PREVENTION BY SIMULATING THE HYDROSTATIC GRADIENT**
Paul Webb *In* NASA. Ames Res. Center Hypogravic and Hypodyn. Environments 1971 p 357–372 refs (See N71-33251 20-04)
Avail: NTIS HC $6.00/MF $0.95 CSCL 06S

Methods of detecting cardiovascular deconditioning and ways of preventing it by simulation of the hydrostatic gradient are described. Briefly discussed are the techniques of continuous and prolonged water immersion, and the use of a special antideconditioning garment that simulates hydrostatic gradient by use of external bladders arranged on the limbs and trunk. A.L.

**N71-33275*#** National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
**RESEARCH DIRECTIONS: DISCUSSION**
*In its* Hypogravic and Hypodyn. Environments 1971 p 373–390 refs (See N71-33251 20-04)
Avail: NTIS HC $6.00/MF $0.95 CSCL 06P

A general discussion is presented of what further studies should be done, particularly those studies that would have practical importance for determining whether man is, or will be, qualified for the very long space flights in the future. Some of the problems to be considered are: the magnitude of mineral loss; the meaning of the apparent depression in 17-hydroxycortocosteroids; factors besides weightlessness that make up the space flight environment; changes in metabolic systems induced by use of countermeasures suits; weightlessness simulation; and deconditioning. A.L.

**N71-33276#** Defense Documentation Center, Alexandria, Va.
**RADIATION EFFECTS, VOLUME 1 Report Bibliography, Jan. 1966–Dec. 1970**
Jun. 1971 383 p refs
(AD-724800; DDC-TAS-71-24-1-Vol-1) Avail: NTIS HC $6.00/MF $0.95 CSCL 6/18

The bibliography contains references on effects of gamma rays, fission fragments, and neutrons, on organisms, food, tissues, the nervous system, etc. The bibliography also includes Corporate Author-Monitoring Agency, Subject, Title, and Personal Author Indexes. Author (GRA)

**N71-33280*#** Boeing Co., Seattle, Wash. Aerospace Group.
**EFFECTS OF AEOLIAN EROSION ON MICROBIAL RELEASE FROM SOLIDS**
E. A. Gustan, R. L. Olson, D. M. Taylor, and R. H. Green Jun. 1971 7 p refs Prepared for JPL
(Contract NAS7-100)
(NASA-CR-121422) Avail: NTIS CSCL 06M

Studies have shown that microorganisms can become encapsulated in selected spacecraft solid materials and under specific conditions survive to arrive on planetary surfaces. This investigation was initiated to determine the percentage of spores that would be expected to be released from the interior of the solid materials by aeolian erosion on a planetary surface. The information obtained can be used in calculations to determine the probability of microbial release in the total planetary quarantine probability equation. Methyl methacrylate and Eccobond discs were fabricated so that each disc contained approximately 40,000 Bacillus subtilis var. niger spores. The discs were placed in a specially designed sandblasting device and eroded. Exposure periods of 0.5, 2 and 24 hours were investigated using filtered air to accelerate the sand. A series of tests was also conducted for a 0.5 hour period using carbon dioxide. Examination of the erosion products showed that less than one percent of the spores originally contained in the solids was released by aeolian erosion. Author

**N71-33401*#** Yale Univ., New Haven, Conn. School of Medicine.
**A MATHEMATICAL MODEL OF PHYSIOLOGICAL TEMPERATURE REGULATION IN MAN**
J. A. J. Stolwijk Washington NASA Aug. 1971 81 p refs
(Contract NAS9-9531)
(NASA-CR-1855) Avail: NTIS CSCL 06P

A dynamic mathematical model is presented of physiological regulation of body temperature in man. A total of 25 nodes is used to represent the thermal characteristics of the body, with four nodes each representing the head, trunk, arms, hands, legs and feet. The twenty-fifth node represents the central blood. Each node has the appropriate metabolic heat production, convective heat exchange with the central blood compartments, and conductive heat exchange with adjacent compartments. The outer nodes represent the skin and exchange heat with the environment via radiation, convection and evaporation. In the model the thermoregulatory system receives temperature signals from all compartments and after integration and processing the system causes appropriate commands to be sent to all appropriate compartments changing metabolic heat production, blood flow or the rate of sweat secretion. The model is presented in the form of a documented FORTRAN program. Simulations of experimental exposures to step changes in environmental temperature at rest and of 30 minute exercise bouts at 25, 50 and 75 percent of maximum aerobic capacity at different ambient temperatures are compared with actual results. Author

**N71-33437*#** Baylor Univ., Houston, Tex. College of Medicine.
**PERIODICITY OF HIGH-ORDER FUNCTIONS IN THE CNS Final Progress Report, Year Ending 30 Jun. 1971**
Peter Kellaway, Robert P. Borda, Alfred C. Coats, and James D. Frost, Jr. 30 Jun. 1971 35 p refs Prepared in cooperation with the Methodist Hospital, Houston, Tex.
(Grant NGR-44-003-001)
(NASA-CR-121409) Avail: NTIS CSCL 06P

The origin and physiological significance of cerebral slow potentials are investigated. The elucidation of the origin of the contigent negative variation, a slow potential which appears to be related specifically to the mechanisms underlying attention and alertness in humans, was emphasized. The investigations were carried out using monkeys as subjects. E.H.W.

**N71-33451#** Joint Publications Research Service, Washington, D.C.
**SPACE BIOLOGY AND MEDICINE, VOLUME 5, NO. 3, 1971**
12 Aug. 1971 150 p refs Transl. into ENGLISH of the publ. 'Kosmicheskaya Biologiya i Meditsina' Moscow, Med. Publishing House, 1971 p 1–92
(JPRS-53801) Avail: NTIS

Research papers on aerospace medical and biological problems of prolonged manned space flights are presented. Topics center on long term physiological effects on the human body caused by confinement in a space capsule and the evaluation of ecological life support system components. For individual titles see N71-33452 through N71-33474.

**N71-33453#** Joint Publications Research Service, Washington, D.C.
**EFFECT OF PROLONGED HYPOKINESIA ON SEROTONIN METABOLISM IN RATS**
Z. S. Dolgun et al *In its* Space Biol. and Med., Vol. 5, No. 3, 1971 12 Aug. 1971 p 15–21 refs (See N71-33451 20-04)
Avail: NTIS

A study was made on the effect of prolonged hypokinesia on serotonin (5-HT) metabolism in rats. It was found that motor activity restriction causes substantial 5-HT metabolism shifts. The most marked deviations from normalcy in the 5-HT content in the duodenal blood and tissues, and also in the excretion of the metabolite of 5-HT 5-hydroxyindolylacetic acid (5-HIAA) in the urine, were observed on the first-third and thirteenth-fifteenth days of hypokinesia. Prolonged (more than 60 days) hypokinesia leads to a considerable increase in the blood 5-HT content; on the 30th and 45th days after emergence from hypokinesia the blood 5-HT content remains high. Author

**N71-33454#** Joint Publications Research Service, Washington, D.C.
**CORRELATION AMONG THE INDICES OF GENERAL AND TISSUE RESISTANCE IN RATS (DURING MUSCLE TRAINING, ADAPTATION TO THE COLD AND DIBASOL INJECTIONS**
V. Ya. Rusin *In its* Space Biol. and Med., Vol. 5, No. 3, 1971 12 Aug. 1971 p 22–27 refs (See N71-33451 20-04)
Avail: NTIS

It was established in experiments on 225 adult white rats that an increase in resistivity of the intact organism to different unfavorable factors under the influence of muscular training, adaptation to the cold, and dibasol injections has a reliable correlation with the increase in resistance at the tissue and cell levels. It therefore follows that by applying methodologically extremely simple tissue and cell resistance criteria one can check the means and methods for increasing body biological reserves. Author

**N71-33455#** Joint Publications Research Service, Washington, D.C.
**CULTIVATION OF MAMMAL CELLS AT 'SUBOPTIMUM' TEMPERATURES**
F. V. Sushkov et al *In its* Space Biol. and Med., Vol. 5, No. 3, 1971 12 Aug. 1971 p 28–32 refs (See N71-33451 20-04)
Avail: NTIS

Cultures of L, HeLa, and VNK-21 cells, A-1, FL, RH human amnion and kidney cells, and Chinese hamster cells of sublines 237 and 431 were cultivated at temperatures of 37 and 36-28 C with an interval of 2 + or – 0.5 C. L, A-1, BHK-21 cells and Chinese hamster cells were found to be capable of mitotic division at 30 and 28 C. Proliferation of L cells was maintained for 19 months (42 subinoculations); other cell lines tolerated two or three subinoculations (20-30 days) under these conditions. The adaptation of L cells involved substantial cytophysiological changes which reflected the adaptation process, which is obviously phenotypical. Author

**N71-33456#** Joint Publications Research Service, Washington, D.C.
**SPINAL CORD REFLEX ACTIVITY IN NORMAL AND**

**LABYRINTHECTOMIZED ANIMALS UNDER THE INFLUENCE OF RADIAL ACCELERATIONS**

G. S. Ayzikov et al *In its* Space Biol. and Med., Vol. 5, No. 3, 1971 12 Aug. 1971 p 33–39 refs (See N71-33451 20-04)
Avail: NTIS

A study was made of spinal cord induced potentials (H-reflex) in intact and labyrinthectomized rats at accelerations of 0.5-8 g in a head-pelvis direction. The combined effect of accelerations in the range from 0.5 to 8 g considerably changed spinal cord reflex activity. At 0.5 g the H-reflex increased in amplitude and returned to the background values after rotation ceased. At 2, 4 and 8 g the reflex was suppressed in direct proportion to the acceleration. The time for reflex restoration also increased with an increase in acceleration. During accelerations the functional state and activity of the motor analyzer were determined by a combination of factors. In labyrinthectomized animals the depression of spinal activity manifested a muscle dependence of the exposure. Author

**N71-33457#** Joint Publications Research Service, Washington, D.C.

**EFFECT OF ABDOMINAL OR HEAD REGION SHIELDING DURING GAMMA IRRADIATION OF DOGS ON THE CONTENT OF BLOOD SERUM PROTEIN FRACTIONS**

B. I. Davydov et al *In its* Space Biol. and Med., Vol. 5, No. 3 1971 12 Aug. 1971 p 40–45 refs (See N71-33451 20-04)
Avail: NTIS

Dogs were exposed to gamma-irradiation in a dose of 600 R with shielding of the abdominal (dose behind shield 150 and 300 R) or head (dose behind shield 150 R) regions. Protein fractions in the blood serum were determined by the paper electrophoresis method. A decrease in the albumin-globulin coefficient was noted regardless of shield localization; there was an increase in the content of beta-globulins with normalization by the 100th day in the case of abdominal shielding and a residual dose behind the shield of 150 R and an increase in the albumin-globulin coefficient, for the most part due to the alpha sub 2 fraction. The increase in globulins correlates with an increase in glutamate-aspartate transferases. Author

**N71-33458#** Joint Publications Research Service, Washington, D.C.

**IMPORTANCE OF THE MOTOR AND VESTIBULAR ANALYZERS AND FRONTAL HYPOTHALAMUS IN COMPENSATING A GRAVITATIONAL LOAD DURING ORTHOSTASIS**

G. S. Belkaniya *In its* Space Biol. and Med., Vol. 5, No. 3, 1971 12 Aug. 1971 p 46–53 refs (See N71-33451 20-04)
Avail: NTIS

In experiments on intact cats and also against a background of curarization, bilateral vestibular deafferentation and electrocoagulation of the frontal hypothalamus, it was possible to determine the phase nature of changes in respiration, arterial pressure and cerebral bioelectric activity during orthostasis. There is a distinct dependence between the rate of development of orthostatic collapse and the nature of the primary vascular reaction; this determines its prognostic importance. Elimination of the vestibular motor analyzer and electric coagulation of the frontal hypothalamus sharply reduce the gravitational function during orthostasis. Orthostatic tolerance is regarded as a special manifestation of the general mechanism of body spatial orientation. Author

**N71-33459#** Joint Publications Research Service, Washington, D.C.

**FORMULATION OF PHYSIOLOGICAL PRINCIPLES FOR RATIONAL HEAT TRANSFER IN INDIVIDUAL INSULATING GEAR**

S. M. Gorodinskiy *In its* Space Biol. and Med., Vol. 5, No. 3, 1971 12 Aug. 1971 p 54–62 refs (See N71-33451 20-04)
Avail: NTIS

Experimental data are given on validating the physiological principles for approach to heat transfer in an individual insulating suit. The body regions from which the most effective heat transfer can be ensured because of their anatomical-physiological characteristics were determined. The undesirability of heat transfer primarily from body regions situated over the main muscle groups of the extremities is noted; this is true because the conditions for heat removal from them are less favorable than from the sectors situated over tendons and poorly expressed muscle layers; the possibility of local overcooling of the muscles can lead to a decrease in their performance. Author

**N71-33460#** Joint Publications Research Service, Washington, D.C.

**USE OF COLOR-MUSIC IN AN OPERATOR'S WORK DURING ISOLATION**

Yu. A. Petrov et al *In its* Space Biol. and Med., Vol. 5, No. 3, 1971 12 Aug. 1971 p 63–68 refs (See N71-33451 20-04)
Avail: NTIS

In order to prevent possible impairments in the psychophysiological sphere of an operator during prolonged isolation provisions must be made for a special organization of the interior. Color-musical compositions are an element of this interior. The timeliness of the use of color and music for this purpose is considered and the principles for selecting color and musical programs are defined. Author

**N71-33462#** Joint Publications Research Service, Washington, D.C.

**CYTOGENETIC INVESTIGATIONS IN RELATION TO MANNED SPACE FLIGHT**

L. P. Grinio et al *In its* Space Biol. and Med., Vol. 5, No. 3, 1971 12 Aug. 1971 p 77–83 refs (See N71-33451 20-04)
Avail: NTIS

No increase in chromosomal aberrations was found in the blood of test subjects during a 120 day bed rest experiment. No significant changes in the chromosomal apparatus were detected in cytogenetic examinations of a cosmonaut. These findings indicate that manned space flights made along the trajectories and in radiation environments involved up to this time are genetically safe. Author

**N71-33463#** Joint Publications Research Service, Washington, D.C.

**CHANGES IN HUMAN RETINAL CIRCULATION DURING TRANSVERSE ACCELERATION**

A. S. Barar et al *In its* Space Biol. and Med., Vol. 5, No. 3, 1971 12 Aug. 1971 p 84–90 refs (See N71-33451 20-04)
Avail: NTIS

Data obtained using a teleophthalmoscopic system give evidence that the blood filling of retinal vessels decreases in response to accelerations of 6 and 8 g. Exposure to 10 and 12 g disturbs blood flow continuity in retinal vessels, giving rise to optical disturbances. These phenomena may be accounted for by changes in systemic and regional circulation. Their level is correlated with the values of the acceleration components coinciding with the direction of the vascular bed. In the pathogenesis of the described vascular disturbances an increase in hydrostatic pressure in the region of the eye back pole is of a certain significance. Author

**N71-33464#** Joint Publications Research Service, Washington, D.C.

**CHARACTERISTICS OF THE NASAL VASCULAR SYSTEM REACTION DURING 120-DAY HYPOKINESIA**

I. Ya. Yakovleva *In its* Space Biol. and Med., Vol. 5, No. 3, 1971 12 Aug. 1971 p 91–97 refs (See N71-33451 20-04)
Avail: NTIS

During a 120 day bedrest experiment the dynamics of intranasal circulation was investigated by the rhinopneumometric technique. Each test subject exhibited changes in nasal circulation from the third to the twelfth day of hypokinesia. The responses varied from subject to subject but for the most part were similar, involving an increase in the blood filling of the nasal conchae and vasomotor innervation liability. The changes were more pronounced in cases of autonomic and vascular dysfunction. Drugs produced no distinct effect on nasal circulation responses. Hemodynamic disturbances of the nasal mucosa were due to changes in hydrostatic blood pressure, followed by neuroendocrinal shifts. Author

**N71-33465#** Joint Publications Research Service, Washington, D.C.

**ELECTRIC ACTIVITY OF LEG MUSCLES DURING STANDING AFTER A 120-DAY BEDREST CONFINEMENT**

B. N. Petukhov et al *In its* Space Biol. and Med., Vol. 5, No. 3, 1971 12 Aug. 1971 p 98–104 refs (See N71-33451 20-04)
Avail: NTIS

Changes in the electromyograms (EMG) of 10 healthy subjects were studied following a 120 day bedrest experiment. The test subjects were classified into three groups: the first, a control group, included four persons; the second and third groups included three men each. The second group of test subjects received pituitrin and DOCA to prevent changes in water and mineral metabolism. The test subjects in the third group were given Nerabol to prevent deviations in protein metabolism. After the hypokinesia the EMG amplitude exhibited a distinct decrease in the test subjects of the first and third groups and a less marked decrease in the second group of test subjects. Author

**N71-33466#** Joint Publications Research Service, Washington, D.C.

**CHANGE IN CARDIAC EJECTION UNDER THE INFLUENCE OF 15-DAY BED CONFINEMENT**

B. S. Katkovskiy et al *In its* Space Biol. and Med., Vol. 5, No. 3, 1971 12 Aug. 1971 p 105–113 refs (See N71-33466 20-04)
Avail: NTIS

A significant increase in cardiac output related mainly to stroke volume was observed in five male test subjects during a 15 day bedrest experiment. Oxygen consumption and carbon dioxide production decreased gradually during the observation period. It is suggested that similar changes in cardiac output occur in an early period of adaptation to weightlessness during spaceflight. Author

**N71-33467#** Joint Publications Research Service, Washington, D.C.

**CORRELATION BETWEEN RENAL EXCRETION OF DIFFERENT CATIONS UNDER CONDITIONS OF AN IMPAIRED MINERAL BALANCE**

I. S. Balakhovskiy et al *In its* Space Biol. and Med., Vol. 5, No. 3, 1971 12 Aug. 1971 p 114–118 refs (See N71-33451 20-04)
Avail: NTIS

Human subjects were investigated to clarify the interrelationship between renal elimination of sodium and calcium in order to make a more thorough analysis of changes in electrolyte balance during space flight. A broad range of changes in the state of water-mineral metabolism was attributed to prolonged exposure at high temperature and restricted mobility. Author

**N71-33468#** Joint Publications Research Service, Washington, D.C.

**AMINOSILICAGELS: REGENERABLE SORBENTS FOR ABSORBING CARBON HYDROGEN SULFIDE AND WATER VAPOR**

I. A. Danilychev et al *In its* Space Biol. and Med., Vol. 5, No. 3, 1971 12 Aug. 1971 p 119–122 refs (See N71-33451 20-04)
Avail: NTIS

Amino silica gels were synthesized and tested for their absorption effectiveness in spacecraft atmospheric purification systems. Sorption characteristics with carbon dioxide, hydrogen sulfide, and other substances of acid nature provided optimal regeneration capacities for atmospheres in pressurized cabins and also in a number of industrial branches. G.G.

**N71-33469#** Joint Publications Research Service, Washington, D.C.

**NATURE AND DISTRIBUTION OF INTRAOCULAR PRESSURE IN HEALTHY PERSONS AGES 25–40 ENGAGED IN MENTAL WORK**

T. A. Petrov et al *In its* Space Biol. and Med., Vol. 5, No. 3, 1971 12 Aug. 1971 p 123–126 refs (See N71-33451 20-04)
Avail: NTIS

The detection of latent pathology in humans by intraocular pressure measurements was investigated. Tonometric measurements on 25 to 40 year old subjects engaged in mental work showed that intraocular pressure in itself can be evidence of the degree of probability of disease but is not an absolute criterion of normalcy or a pathological condition. Analysis of obtained intraocular pressure distribution curves established an isolated group of individuals whose indices exceeded a normal distribution range. Author

**N71-33470#** Joint Publications Research Service, Washington, D.C.

**MORPHOLOGICAL CHANGES IN MYOCARDIUM DURING MULTIHOUR ACCELERATIONS**

P. I. Katunyan et al *In its* Space Biol. and Med., Vol. 5, No. 3, 1971 12 Aug. 1971 p 127–129 refs (See N71-33451 20-04)
Avail: NTIS

The results of a study on a series of histological, histochemical and electron microscope manifestations of myocardial reactions under the influence of + 2G sub Z accelerations are reported. Observed are the hearts of 36 male rats weighing 200-250 g which were exposed to + 2G sub Z accelerations for periods of 8, 16, and 24 hours on a centrifuge with a 70 cm arm and also studied are the aftereffects 24 and 72 hours after the centrifuge was stopped. A well expressed dependence of dystrophic myocardial damage on acceleration duration is established. Structural changes in cardiac muscle cells and increased capillary permeability observed after continuous acceleration exposure for 24 hrs are indications of dystrophic damage to the myocardium resulting from impaired hemodynamics. Author

**N71-33471#** Joint Publications Research Service, Washington, D.C.

**OPTIMIZATION OF THE MINERAL COMPOSITION OF A NUTRIENT MEDIUM FOR HYDROGENOMONAS**

V. K. Kovalenkova et al *In its* Space Biol. and Med., Vol. 5, No. 3, 1971 12 Aug. 1971 p 130–132 refs (See N71-33451 20-04)
Avail: NTIS

The efficiency of autotropic cultivation of Hydrogenomonas in a modified Schlegel nutrient was studied by comparing increment biomass weight with that obtained for pure Schlegel cultivations.

Culture density levels in media where $NH_4Cl$ was replaced by urea increased markedly when nutrient salt concentration was reduced sixfold. G.G.

**N71-33472#** Joint Publications Research Service, Washington, D.C.

**RESULTS OF COMBINED EXPOSURE OF CHLORELLA TO VIBRATION AND GAMMA IRRADIATION**

I. D. Anikeyeva et al *In its* Space Biol. and Med., Vol. 5, No. 3, 1971 12 Aug. 1971 p 133–136 refs (See N71-33451 20-04)

Avail: NTIS

An attempt was made to evaluate the possible effects exerted by mechanical vibration and vibration in combination with gamma irradiation on the unicellular green alga Chlorella vulgaris, a proposed component of closed ecological systems. Experiments show that there are no appreciable differences in the rate of cell development and the nature of sporulation detectable either in the case of acute or chronic irradiation. Vibration in itself exerted no significant effect, nor did it in combination with irradiation. Author

**N71-33473#** Joint Publications Research Service, Washington, D.C.

**ONE PROPERTY OF THE OVERALL CHARACTERISTICS OF VESTIBULAR NYSTAGMUS**

A. A. Shipov *In its* Space Biol. and Med., Vol. 5, No. 3, 1971 12 Aug. 1971 p 137–140 refs (See N71-33451 20-04)

Avail: NTIS

Experiment on male guinea pigs were performed to determine nystagmic reactions to angular accelerations of increased intensity and lengths. It was demonstrated that the number of beats, duration and frequency of nystagmus in animals exposed to angular accelerations successively increasing in intensity increased with an increase in acceleration intensity. The nystagmic reaction to each of the used accelerations was less than for animals subjected to a single investigation during rotation with acceleration of a particular intensity. Author

**N71-33486#** Battelle-Northwest, Richland, Wash.

**VARIOUS HOLOGRAPHIC SCANNING CONFIGURATIONS FOR UNDER SODIUM VIEWING**

H. Dale Collins Mar. 1971 45 p refs

(Contract AT(45-1)-1830)

(BNWL-1558) Avail: NTIS

Various holographic scanning configurations were investigated that could be used for acoustic imaging in liquid sodium. Different scanning configurations were analyzed and experiments were performed to verify the unique properties of each configuration. A general analysis is presented of acoustical scanned holography with phase-shifting the electronic reference beam, and various scanning configurations are composed for viewing in liquid sodium. The optimum holographic imaging configuration in liquid sodium consists of scanning either a focused or point source and receiver transducer and phase shifting the electronic reference. The optimum frequency used for illumination is determined by the required resolution and range of the imaging system. Author

**N71-33501#** Joint Publications Research Service, Washington, D.C.

**BIOGEOCENOLOGY TODAY AND TOMORROW**

3 Aug. 1971 34 p refs Transl. into ENGLISH of various articles from Priroda (Moscow), no. 6, 1971 p 4–13

(JPRS-53743) Avail: NTIS

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**N71-33502#** Joint Publications Research Service, Washington, D.C.

**CURRENT TASKS OF BIOGEOCENOLOGY**

Ye. M. Lavrenko *In its* Biogeocenology Today and Tomorrow 3 Aug. 1971 p 2–6 refs (See N71-33501 20-04)

Avail: NTIS

Russian activities in the field of biogeocenoses are discussed. The study of the structure of biogeocenoses, the trophic (food) relations among their living components, and metabolic processes in biogeocanoses, including biological productivity, is the specific nature of biogeocenological research. The physical structure of biogeocenoses and the interrelations among their components are discussed. Author

**N71-33503#** Joint Publications Research Service, Washington, D.C.

**POPULATION STRUCTURE OF BIOGEOCENOSES**

S. S. Svarts *In its* Biogeocenology Today and Tomorrow 3 Aug. 1971 p 7–10 (See N71-33501 20-04)

Avail: NTIS

Approaches to biogeocenotic research are discussed. Two approaches are proposed. The first is to study a specific cenosis in all aspects of its internal dynamic organization and external ties. The second is to investigate the most important biogeocenotic processes and phenomena, whose aggregate ultimately determines the laws of life of the biosphere. Author

**N71-33504#** Joint Publications Research Service, Washington, D.C.

**STATION INVESTIGATIONS OF TUNDRA BIOGEOCENOSES**

B. A. Tikhomirov *In its* Biogeocenology Today and Tomorrow 3 Aug. 1971 p 11–12 (See N71-33501 20-04)

Avail: NTIS

Station investigations of tundra biogeocenoses are discussed. Expansion of station research and the setting up of a number of experiments in the tundra are prerequisites for successful management of the tundra, for rational use of resources, and for increasing productivity. Author

N71-33505# Joint Publications Research Service, Washington, D.C.

**FROM DOKUCHAYEV'S NATURAL ZONES TO SPACE ECOSYSTEMS**

O. G. Gazenko et al *In its* Biogeocenology Today and Tomorrow 3 Aug. 1971 p 13–14 (See N71-33501 20-04)

Avail: NTIS

Applications of the theory of natural zones and space ecosystems are presented. Biogeocenology originated with the Russian study of soil science and creation of the scientific disciplines of geographic and genetic soil science. Author

N71-33506# Joint Publications Research Service, Washington, D.C.

**EXPERIMENTAL BIOGEOCENOLOGY**

A. N. Tyuryukanov *In its* Biogeocenology Today and Tomorrow 3 Aug. 1971 p 15–16 (See N71-33501 20-04)

Avail: NTIS

The use of radioisotopes for observing changes in the structure or turnover of substances in biogeocenoses is discussed. Tracer atoms have made it possible to obtain results such as: (1) determination of the nature of chemical and biochemical ties in biogeocenoses, (2) the study of the effect of radioisotopes on organisms, and (3) determination of the coefficients of accumulation by organisms of various elements. Author

N71-33507# Joint Publications Research Service, Washington, D.

**MICROBIC CENOSES AND FERTILITY**

Ye. N. Mishustin *In its* Biogeocenology Today and Tomorrow 3 Aug. 1971 p 17–18 (See N71-33501 20-04)

Avail: NTIS

The role of microbes in biogeocenoses is discussed. The effects of microbes on the fertility of the soil are examined. Various aspects of soil science which will produce increased fertility are described. Author

N71-33508# Joint Publications Research Service, Washington, D.C.

**BIOGEOCENOLOGY AND WATER TREATMENT**

M. M. Kamshilov *In its* Biogeocenology Today and Tomorrow 3 Aug. 1971 p 19 (See N71-33501 20-04)

Avail: NTIS

The application of biogeocenology to the problem of water pollution is discussed. The self-cleaning capability of the Volga river is described and the influences of various chemicals and organisms on water cleanliness are reported. Author

N71-33509# Joint Publications Research Service, Washington, D.C.

**THE STRUCTURE AND FUNCTION OF BIOGEOCENOSES**

N. V. Dylis *In its* Biogeocenology Today and Tomorrow 3 Aug. 1971 p 20–22 (See N71-33501 20-04)

Avail: NTIS

The structure and function of biogeocenoses are presented. The role of individual components of a biogeocenosis in the organization of its structure and functions is not uniform and is specific. Changes in the autotrophic link of a system and the resulting effects are described. Author

N71-33510# Joint Publications Research Service, Washington, D.C.

**PHOTOSYNTHESIS AND THE PRODUCTIVITY OF CENOSES**

A. A. Nichiporovich *In its* Biogeocenology Today and Tomorrow 3 Aug. 1971 p 23–25 (See N71-33501 20-04)

Avail: NTIS

The process of photosynthesis and its relation to the production of cenoses is discussed. The process of the formation of the primary organic product is the initial stage in the life activity of any biogeocenosis. This stage is subject to complex special laws that require special study and special regulatory steps. Author

N71-33511# Joint Publications Research Service, Washington, D.C.

**BIOGEOCENOLOGY OF THE WATER ENVIRONMENT**

G. G. Vinberg *In its* Biogeocenology Today and Tomorrow 3 Aug. 1971 p 26–27 (See N71-33501 20-04)

Avail: NTIS

The biogeocenology of the water environment is discussed. Water systems are distinguished from terricolous systems by the fact that there are dozens and hundreds of times more animals in the water environment than on land. Determination of the primary product is the first task of water biogeocenology. Author

N71-33512# Joint Publications Research Service, Washington, D.C.

**ENERGY BALANCE OF A BIOGEOCENOSIS**

A. A. Molchanov *In its* Biogeocenology Today and Tomorrow 3 Aug. 1971 p 28–30 (See N71-33501 20-04)

Avail: NTIS

The effect of solar radiation and its utilization on the potential biological productivity of various terricolous biogeocenoses is discussed. The flow of solar energy with short wave and long wave radiation is reflected from a biogeocenosis, absorbed or transmitted, converted, and finally returned to space. Author

N71-33513# Joint Publications Research Service, Washington, D.C.

**IMPORTANCE OF BIOGEOCENOLOGY IN LAND RECLAMATION**

N. I. Pyavchenko *In its* Biogeocenology Today and Tomorrow 3 Aug. 1971 p 31–32 (See N71-33501 20-04)

Avail: NTIS

The application of biogeocenology principles to land reclamation operations is discussed. Marsh biogeocenoses belong to a special type of the biosphere's accumulating systems. They are very important accumulators of and storehouses for the tremendous reserves of connected bodies of water. Author

N71-33577# South Dakota Univ., Vermillion. Dept. of Biochemistry.

**EFFECTS OF ULTRAVIOLET RADIATION ON ALGAE: MECHANISMS OF INACTIVATION AND REPAIR Annual Progress Report, 1 May 1970–30 Apr. 1971**

Gary D. Small 1971 4 p refs

(Contract AT(11-1)-1793)

(COO-793-5) Avail: NTIS

A photoreactivating enzyme was detected in Chlamydomonas reinhardi and Euglena gracillis using the Hemophilus influenzae transformation assay. Photoreactivating enzyme activity was found in extracts of chloroplasts isolated from Euglena. Studies on detection of ultraviolet-induced photoproducts in DNA of algae included development of a method for isolating pyrimidine dimers from enzymic digests of irradiated P-32 labeled DNA. A DNase with a high specificity toward single-stranded DNA was purified for studies on enzymes that may have a role in repair and replication of DNA. NSA

**N71-33722#** Institute for Sensory Physiology RVO-TNO, Soesterberg (Netherlands).
**PSYCHOPHYSICAL MEASURES OF SENSORY SENSITIVITY [PSYCHOFYSISCHE MATEN VOOR SENSORISCHE GEVOELIGHEID]**
W. H. Janssen 1971 26 p refs In DUTCH; ENGLISH summary
(IZF-1971-13; TDCK-58082) Avail: NTIS

It is shown that measures and procedures based on the threshold idea are not satisfactory. Newer measures have not been elaborated sufficiently to be able to use them with confidence. Determining signal detection theory parameters by means of confidence ratings is the preferable procedure, since a reliable technique of estimation has been developed for estimating parameters from data of this type. Yes-no and forced choice procedures of measurement are inadequate. Author

**N71-33823#** Institute for Perception RVO-TNO, Soesterberg (Netherlands).
**SPECTRAL SENSITIVITY OF MACAQUE CONES DETERMINED WITH AN ERG METHOD**
D. van Norren and P. Padmos 1971 16 p refs
(IZF-1971-10; TDCK-57935) Avail: NTIS

The spectral sensitivity of macaque monkeys was determined by flicker-electroretinography. Strong colored backgrounds were applied to bleach away one or two of the three fundamental cone systems. With a strong yellow background a blue sensitive system could be isolated. This system is more sensitive to longer wavelengths compared to the human blue system. A deep red background suppresses the red system. Thus the spectral sensitivity of the green sensitive system could be derived. Strong blue backgrounds were less selective in suppressing the blue and green system so that no definite conclusions about the shape of the red system could be drawn. Some theoretical considerations on the method of selective adaptation are given. Author

**N71-33859#** Institute for Perception RVO-TNO, Soesterberg (Netherlands).
**PSYCHOPHYSICAL EVIDENCE FOR LATERAL INHIBITION IN HEARING**
T. Houtgast 1971 35 p refs
(IZF-1971-8; TDCK-57803) Avail: NTIS

Although there are some indications of the possible role of lateral inhibition in hearing, there has been no clear demonstration of it in psychophysical experiments. Either the phenomenon plays only a minor role, or it has escaped psychophysical verification. Accepting for a moment the second possibility it is argued that the threshold of a test-tone presented simultaneously with a masker does not reflect clear lateral inhibition effects since the inhibition affects both the test tone and the masker. Two different methods, in which the test tone and the masker were presented successively, give clear psychophysical evidence of lateral inhibition in hearing. First, the threshold curve of short test tone bursts presented in the gaps between repeated masker bursts (noise with a steep negative or positive gradient at a particular frequency) show marked edge effects. Secondly, the results of psychophysical measurements on two tone suppression indicate that the nervous activity due to one frequency component may be suppressed by another component. The effect at the edges of the frequency spectrum are comparable with visual Mach bands, and the interaction of two tones is suggestive of the two tone inhibition found in auditory nerve fibers. Author

**N71-33934#** Institute for Cancer Research, Philadelphia, Pa.
**STUDIES OF THE EFFECTS OF ULTRAVIOLET RADIATION ON CELL STRUCTURE AND BEHAVIOR Comprehensive Report, 1967 - 1970**
Jerome J. Freed 25 Jan. 1971 11 p refs
(Contract AT(30-1)-2356)
(NYO-2356-43) Avail: NTIS

Radiation studies were continued on cell behavior in relation to underlying cytoplasmic structure and differential activity of genes. For studies on microtubules as determinants of cell behavior, phase contrast time lapse and electron microscopy were used and a flying spot microscope was developed. Studies on the effects of colchicine on saltatory movement in cells showed that these movements were associated with an aster-like array of cytoplasmic microtubules. Other studies were conducted on amino acid deprivation as a source of chromosome aberrations. Haploid cells of frogs were used for transfer of nuclei from monolayer cultured cells to enucleated eggs to determine effects of variant nuclei in embryonic development. NSA

**N71-33970#** Deutsche Gesellschaft fuer Luft- und Raumfahrt, Meckenheim (West Germany).
**ANTHROPOTECHNOLOGY [ANTHROPOTECHNIK]**
H. Dupuis, S. Fichtbauer, G. W. Redl, and H. L. Vogt Apr. 1970 101 p refs In GERMAN; ENGLISH summary Presented at 8th Session of the WGLR Comm. for Anthropotechnol., Munich, 28 Nov. 1969
(DLR-Mitt-70-11) Avail: NTIS; ZLDI Munich: 21.20 DM

Four papers dealing with the measurement of human psychic and physical stress are reported as the results of an extensive experimental program to determine the influence of vibrations on the human body. A survey on the role of parallel tasks in determining psychic stress which includes a list of convenient references is given. Some basic experimental problems and different methods e.g. task-analysis-techniques, applications of control theories, psycho-physiological data recording, perceptual psychology-methods and the use of rating scales are outlined together with the use of electrophysiological methods in these fields. Author

# 05 BIOTECHNOLOGY

Includes life support systems, human engineering; protective clothing and equipment; crew training and evaluation and piloting. For related information see also: 04 Biosciences.

**N71-32826#** Picatinny Arsenal, Dover, N.J.
**FIELD DEPENDENCE AND VISUAL DETECTION ABILITY**
Bruce L. Bucklin May 1971 62 p refs
(AD-724115; PA-TR-4137) Avail: NTIS CSCL 5/10

The perceptual style known as field independence has been defined by various investigators as the ability to perceptually separate an object from within a complex background. This investigation attempts to test this concept in a literal manner by examining the relationship between several established measures of field independence and performance on a real-life visual detection problem. Only one of the instruments used, the Hidden Figures Test, correlated significantly with performance. An added finding was a correlation between performance and general intelligence. Furthermore, interest correlations showed that the instruments used could be divided into two groups, each measuring what appears to be a separate quality of the field independence concept. Author (GRA)

**N71-32864#** Southampton Univ. (England). Inst. of Sound and Vibration.
**SOME EFFECTS OF THE VIBRATION OF READING MATERIAL UPON VISUAL PERFORMANCE**
J. G. O'Hanlon and M. J. Griffin May 1971 47 p refs

Sponsored by Min. of Defence
(ISVR-TR-49) Avail: NTIS

An investigation has been made of the changes in visual acuity when viewing an object vibrating in the frequency range from 5 to 40 Hz. Reading time, error score, and subjective rating of reading difficulty were used as indicators of performance at a Landolt C acuity task. Three experiments were conducted. The first showed that errors increased with frequency from 5 to 40 Hz and with double amplitude from 0.05 in to 0.20 in. Two further experiments investigated in more detail: (1) varying amplitude at constant frequency, 16 Hz; (2) varying frequency at constant double amplitude, 0.1 in. It was found that error score was proportional to the square root of the amplitude of vibration and that the error score was directly proportional to frequency. A relatively small increase in test object size appreciably reduced errors; a 75% reduction in errors was produced by only a 25% increase in the size of the Landolt C's. The same size increase resulted in up to 20% reduction in the time taken to complete the reading task.
Author (ESRO)

**N71-32865#** Southampton Univ. (England). Inst. of Sound and Vibration Research.
**BEHAVIOURAL AWAKENING IN RESPONSE TO INDOOR SONIC BOOMS**
P. A. Morgan and C. G. Rice Dec. 1970 40 p refs Sponsored by Min. of Technol.
(ISVR-TR-41) Avail: NTIS

A behavioral awakening study, involving subjection tests of eight persons (mean age 22.9 years), who were each variously exposed to double event impulse noise simulations of a sonic boom over a period of seven consecutive nights, is reported on.
ESRO

**N71-32925#** Army Natick Labs., Mass. Clothing and Personal Life Support Equipment Lab.
**THE BEHAVIOR OF PROTECTIVE UNIFORMS IN LARGE SCALE SIMULATED FIRES**
Mar. 1971 51 p
(AD-724648; C/PLSEL-TS-172; USA-NLABS-TR-71-40-CE) Avail: NTIS CSCL 6/17

The report describes a new test facility developed at the U. S. Army Natick Laboratories for exposing clothed manikins to large fuel (JP-4) fires and gives the results of evaluations made of several protective systems developed for hot and cold weather aviators uniforms.
Author (GRA)

**N71-33087#** New Mexico State Univ., University Park. Dept of Psychology.
**PREDICTING HUMAN PERFORMANCE 2: LAWS OF THE VISUAL REACTION TIME**
Warren H. Teichner and Marjorie J. Krebs Apr. 1971 59 p refs
(AD-724001; NMSU-ONR-TR-71-1) Avail: NTIS CSCL 5/10

The literature on the reaction time to a flash of light was reviewed and 14 studies published between 1896 and 1969 were selected as having provided sufficient methodological detail and data appropriate for quantitative analysis of the effects of the following selected variables: Luminance, duration, size of stimulus, contrast, and background luminance, response to stimulus onset vs. offset of the signal, and monocular vs. binocular viewing. Conclusions were drawn about the effects of each variable and/or the status of the research literature concerning it. Mathematical relationships were developed which can be used to predict binocular RTs over a wide range of luminance, signal duration and signal size. These relationships appear sufficiently reliable to be used for purposes of equipment design. The data were also considered in theoretical terms. It was shown that the product of RT and luminance may be used to represent a response criterion in the sense implied by the theory of signal detection as developed in recent latency models.
Author (GRA)

**N71-33088#** Defense Documentation Center, Alexandria, Va.
**ENVIRONMENTAL POLLUTION: NOISE POLLUTION EAR PROTECTORS, VOLUME 1 Report Bibliography, Nov. 1943–Sep. 1970**
Jun. 1971 68 p refs
(AD-724650; DDC-TAS-71-23-1) Avail: NTIS CSCL 20/1

This is Volume I of a two-volume set on Environmental Pollution: noise Pollution - Ear Protectors in a series of bibliographies on Environmental Pollution. Annotated references concerning ear protective devices, such as earmuffs, earplugs and helmets to be used against airplane noise, gun blasts, industrial plant noise, high-intensity impulse noise, combat noise, and guided missile launchings are included. Corporate Author-Monitoring Agency, Subject, Title, and Report Number indexes are included.
Author (GRA)

**N71-33123#** Army Test and Evaluation Command, Aberdeen Proving Ground, Md.
**AVIATION HELMETS Final Report**
26 Apr. 1971 21 p refs
(AD-724080; MTP-7-3-085) Avail: NTIS CSCL 6/17

Procedures are provided for determining the functional suitability of aviation helmets. Protective features and compatibility with airborne communication systems are discussed.
Author (GRA)

**N71-33125#** Navy Experimental Diving Unit, Washington, D.C.
**REVISED TABLES OF APPROPRIATE OXYGEN PERCENTAGES FOR SELECTED PARTIAL PRESSURES AT VARIOUS DEPTHS Final Research Report**
Thomas E. Berghage and Gilbert C. Tolhurst 1 Apr. 1971 94 p refs Revised
(AD-724282; NEDU-RR-4-71) Avail: NTIS CSCL 6/11

The report was written to promulgate a revised set of tables to allow rapid and easy conversion of water depth and partial pressure combinations into appropriate oxygen per cent to be used by divers and diving supervisors. The tables were devised for use when making necessary conversions between depth in feet of sea water and pressure in terms of atmospheres absolute.
Author (GRA)

**N71-33138#** Human Engineering Labs., Aberdeen Proving Ground, Md.
**COLOR, DIFFERENTIAL LUMINANCE AND SUBJECTIVE DISTANCE**
Claude N. McCain, Jr. and A. Charles Karr Apr. 1971 19 p refs
(AD-724623; HEL-TM-4-71) Avail: NTIS CSCL 5/10

A modified Howard-Dohlman type apparatus was used to quantify the ability of 12 observers to adjust the relative distance of grey, red and blue rods under six relative luminance combinations (left or right rod having equal, one-half, or one-quarter the luminance of its comparison rod). The observers perceived the red rod as nearer than the blue under all conditions, with no significant effect of luminance under any condition. It was concluded that color per se is a cue for depth.
Author (GRA)

**N71-33148#** Human Resources Research Organization, Alexandria, Va.
**PREDICTION OF ARMY AVIATOR PERFORMANCE: DESCRIPTION OF A DEVELOPING SYSTEM**

Wiley R. Boyles and James L. Wahlberg Apr. 1971 11 p refs Presented at the Ala. Psychological Assoc. Ann. Meeting, Ala., May 1970 *Its* HumRRO Prof. Paper No. 5-71
(Contract DAHC19-70-C-0012)
(AD-724696) Avail: NTIS CSCL 5/9

The development of a multivariate prediction system aimed at having useful predictors available early in the training of potential Army aviators is discussed. Using this system, supervisors will be able to relate a predictor score to a probability table, this enabling administrators to make early decisions involving further training of Army aviators. Author (GRA)

N71-33149# Human Resources Research Organization, Alexandria, Va.
**PEER RATINGS AS PREDICTORS OF SUCCESS IN MILITARY AVIATION**
James L. Wahlberg, Wiley R. Boyles, and H. Alton Boyd Mar. 1971 Presented at Ala. Psychological Assoc. Ann. Meeting, Ala., May 1970 *Its* HumRRO Paper No. 1-71 19 p refs
(Contract DAHC19-70-C-0012)
(AD-724695) Avail: NTIS CSCL 5/9

Three experimental peer rating forms were developed for use in research in prediction of the aviation training performance criterion--completion/attrition--from the training program for Aviation Warrant Officer Candidates at the U.S. Army Helicopter School. The paper describes the construction of the ratings, the Potential Aviator Rating forms, and compares the validity of these forms with the Contemporary Evaluation Form (CEF) used by the U.S. Army Helicopter School. The basic comparison involved validity between absolute scale and ranks. The original validity coefficients were sufficiently high to anticipate that the use of peer ratings may increase predictive accuracy in a multivariate system. Author (GRA)

N71-33187# Louisville Univ., Ky. Performance Research Lab.
**EFFECTS OF FIGURAL NOISE, ROTATION, AND OTHER TASK VARIABLES ON THE VISUAL PERCEPTION OF FORM**
John B. Thurmond Feb. 1971 53 p refs
(Contract DAHC19-69-C-0009; Proj. Themis)
(AD-723992; ITR-71-18) Avail: NTIS CSCL 5/10

The results of four experimental investigations of the perceptual performance obtained with tasks displaying visual information are reported. Metric figures were used in each experiment--visual forms that are analogs of the amplitude modulated waveforms that characterize the signals of certain sonar and radar presentations. Among the general conclusions reached regarding ways of optimizing visual displays of complex information were the following: The display should provide increased cues for discrimination by enhancing the visibility of features that distinguish one pattern from another rather than providing finer figural detail. Increasing the signal-to-noise ratio of the displayed information will benefit the observer in situations where rotations of the display relative to the observer are unavoidable. Analogs of amplitude-modulated waveforms used to represent complex information visually may be more easily identified when they take the form of patterns that distribute the visual features radially, rather than horizontally, in each shape. Unless practical considerations dictate otherwise, the visually patterned information should be displayed as solid shapes against a uniform background rather than shapes which are outlined in form. Author (GRA)

N71-33329# Aerospace Medical Research Labs., Wright-Patterson AFB, Ohio.
**ENCODING FUNCTION OF SYNCODERS Final Report, Mar. 1967-Mar. 1968**
Marvin C. Ziskin and J. Ryland Mundie Mar. 1971 56 p refs
(AD-724072; AMRL-TR-70-119) Avail: NTIS CSCL 6/4

The syncoder is an electronic information processing device based on neurophysiological principles. Its performance can be separated into a summing function and an encoding function. This report discusses the encoding function. Encoding consists of comparing the output voltage of the summing function with an internally generated time varying threshold voltage. When the voltages are equal, an output pulse is generated and the threshold is reset to its initial value. The entire process is then recycled. The response of the encoding function to time variant and to time invariant signals is presented. Also illustrated are the effects of variations in the syncoder parameters. Author (GRA)

N71-33400*# Hamilton Standard, Windsor Locks, Conn.
**DESIGN AND FABRICATION OF A FLIGHT CONCEPT PROTOTYPE VAPOR DIFFUSION WATER RECLAMATION SYSTEM**
Henry J. Kolnsberg and Donald R. McCann Aug. 1971 169 p refs
(Contract NAS1-8943)
(NASA-CR-111932; SVHSER-5903) Avail: NTIS CSCL 13B

The design, fabrication and test of an experimental vapor diffusion urine water reclamation system are reported. It utilized a polyvinyl chloride membrane and achieved better than 95% recovery efficiency during a 90 day continuous test. The system also incorporated features that exercised microbiological control over the product water. Author

N71-33452# Joint Publications Research Service, Washington, D.C.
**MAN'S PERFORMANCE DURING WEIGHTLESSNESS**
A. A. Korobova et al *In its* Space Biol. and Med., Vol. 5, No. 3, 1971 12 Aug. 1971 p 1-14 refs (See N71-33451 20-04)
Avail: NTIS

Reviewed are studies on the coordination of movements as functions of the osteomuscular system and overall performance during the weightless state. Considered is the nature of impairments in coordination of bodily movements, change in the motor function under lunar gravitational conditions, adaptation to simulated and natural weightlessness conditions, and the role of physical exercises in adaptation to weightlessness. It is concluded that data in the literature on studies of the human motor functions in model experiments and during natural weightlessness of different durations indicate a change in performance and a definite pattern of timing and strength in the execution of movements. G.G.

N71-33461# Joint Publications Research Service, Washington, D.C.
**MODELS OF A MAN-OPERATOR IN INVESTIGATING SPACESHIP MANUAL CONTROL**
R. V. Komotskiy et al *In its* Space Biol. and Med., Vol. 5, No. 3, 1971 12 Aug. 1971 p 69-76 refs (See N71-33451 20-04)
Avail: NTIS

The possibility and feasibility of replacing a man-operator with an appropriate model is discussed and current models in accordance with the main classes of operator's activity are considered. Mathematical descriptions of models and instructions on how to use models in studying manual operation of a spacecraft are provided. Author

N71-33718*# Aerospace Medical Research Labs., Wright-Patterson AFB, Ohio.
**COLD SEA SURVIVAL**
James H. Veghte Oct. 1970 26 p refs
(NASA Order MIPR-T-80489)
(NASA-CR-121449; AD-716389; AMRL-TR-70-72) Avail: NTIS CSCL 06K

Two three-man prototype liferafts were evaluated in Arctic waters off Kodiak Island, Alaska. Surface and core temperatures of each subject were monitored continuously during the 22 hour exposure in the TUL raft and 6 hour exposure in the P-B raft. Each subject wore a different clothing assembly: a NASA full pressure suit, the NASA flight clothing, and the Air Force anti-exposure suit. None of the clothing assemblies was considered adequate to maintain a person in comfort. No significant biochemical shifts in the blood or urine were found. General tolerance times for a variety of cold water-raft exposure are depicted graphically. Author

**N71-33725#** Institute for Sensory Physiology RVO-TNO, Soesterberg (Netherlands).
**VISUAL TROUBLES, DUST PROOF AND ACOUSTIC QUALITIES AS THEY ARE MET WITH PERFORATED WALL COVERING [VISUELE HINDER, STOFWERING EN AKOESTISCHE EIGENSCHAPPEN BIJ HET GEBRUIK VAN GEPERFOREERDE WANDBEKLEDING]**
H. J. Leebeek and H. J. M. Steeneken 1971 9 p In DUTCH; ENGLISH summary
(IZF-1971-12; TDCK-57972) Avail: NTIS

A work situation in a test-cell is described, in which wall covering with a certain acoustic quality is required. The great number of deep holes in the perforated covering causes visual problems for the workers. An explanation of the phenomenon is given as well as means of improvement. A very dark paint would cause less trouble but best solution is the use of thin metal sheet instead of 10 mm plaster material. Author

**N71-33775#** General Electric Co., Philadelphia, Pa. Space Div.
**RESEARCH ON AVALANCHE TYPE SEMICONDUCTOR RADIATION DETECTORS Semiannual Report, Jul.–Dec. 1970**
Philip J. Moldofsky and Peter V. Hewka Jan. 1971 86 p refs
(Contract AT(30-1)-3246)
(NYO-3246-TA-8) Avail: NTIS

Two arrays of three detectors each have been constructed. Each three-detector probe has a detector frontal area of 3 sq cm. In addition, with the detectors arranged as a triangular prism, overall efficiency is increased due to a greater total active detector thickness. Angular dependence of sensitivity is also greatly reduced with this array, making possible a more accurate interpretation of measured count rates in terms of actual interpretation of measured count rates in terms of actual activity of isotope present in an unknown source-detector geometry. Preliminary results show that noise reductions of a factor of 30 are attainable with special voltage sensitive amplifiers, using pulse clipping techniques. Author (NSA)

# 06 CHEMISTRY

**Includes chemical analysis and identification (e.g., spectroscopy). For applications see: 17 Materials, Metallic; 18 Materials, Nonmetallic; and 27 Propellants.**

**N71-32940#** Interuniversitair Reactor Instituut, Delft (Netherlands).
**DETERMINATION OF TRACE MANGANESE AND ZINC IN BUTTER BY ACTIVATION ANALYSIS [BEPALING VAN SPOREN MANGAAN EN ZINK IN BOTER MET BEHULP VAN ACTIVERINGSANALYSE]**
J. J. M. de Goeij, J. J. Kroon, and C. Zegers 1970 7 p ref In DUTCH
(IRI-133-70-03) Avail: NTIS

The preservation of butter can be endangered by traces of copper. One suspects that other transition elements, such as manganese and zinc, can also lead to degradation under certain conditions. Several samples of butter are analyzed, using neutron activation analysis, to determine manganese and zinc content. ESRO

**N71-33098#** Army Missile Command, Redstone Arsenal, Ala. Propulsion Directorate.
**SYNTHESIS AND POLYMERIZATION STUDIES OF 1-FERROCENYL-1,3-BUTADIENE**
D. C. Van Landuyt, J. D. Burnett, and C. W. Huskins 25 Mar. 1971 40 p refs
(AD-723963; RK-TR-71-8) Avail: NTIS CSCL 7/3

The need for elastomeric polymers and/or copolymers containing the organometallic unit (ferrocene) has prompted an attempt to prepare poly-1-ferrocenyl-1,3-butadiene. The preparation and characterization of free-radical and anionic solution homo and copolymers of 1-ferrocenyl-1,3-butadiene is described. Synthesis methods for the ferrocenyl-1,3-butadiene were established. Author (GRA)

**N71-33102*#** National Aeronautics and Space Administration, Ames Research Center, Moffett Field, Calif.
**PRELIMINARY STUDIES OF THE OXIDATION OF TD Ni-20Cr IN STATIC, FLOWING, AND DISSOCIATED OXYGEN AT 1100 C AND 130 N/sq m**
William P. Gilbreath Aug. 1971 16 p refs
(NASA-TM-X-62064) Avail: NTIS CSCL 07D

The degradation behavior of a candidate space shuttle TPS material, TD NiCr, is examined at 1100 C in three oxygen environments at a pressure of 130 N/sq m: static molecular oxygen, flowing molecular oxygen, and flowing atomic oxygen. The last environment, of the three, provides the most reasonable simulation of shuttle orbital vehicle reentry, during oxidation; it also produces several interesting phenomena not normally seen in molecular oxygen. In atomic oxygen, TD NiCr volatilizes faster, has a faster rate of oxide growth, and greater metal recession than occurs in molecular oxygen. The oxide scale formed in atomic oxygen is essentially devoid of chromium and it has a high-temperature emittance that is significantly lower than from the oxides formed in molecular oxygen. In view of these preliminary findings, all candidate shuttle TPS materials are being reexamined to determine their behavior in a dissociated oxygen environment. Author

**N71-33143*#** McDonnell-Douglas Astronautics Co., Huntington Beach, Calif. Biotechnology and Power Department.
**ANALYSIS OF SORBENTS AND CATALYSTS USED DURING A 90-DAY MANNED TEST**
P. P. Mader and A. S. Lucero Jul. 1971 37 p refs
(Contract NAS1-8997)
(NASA-CR-111936) Avail: NTIS CSCL 07D

Materials desorbed from three sorbent beds and from two catalysts used during a 90-day manned test were identified and quantified. Since these sorbents, in addition to their prime function, also showed the tendency to adsorb and accumulate trace contaminants from the atmosphere, this capacity was investigated and compared. The results indicated that the amounts of organic materials adsorbed by a molecular sieve were lower than those adsorbed by silica gel. The largest quantities of organics were adsorbed by activated charcoal. The number of identified organic compounds and their concentrations were far below those identified and measured during the 60-day run. These data indicated that the air inside the space station simulator was of very high purity. The action of Hopcalite and nickel catalysts may be gradually reduced or completely lost by interaction with halogenated organic

compounds. These compounds were formed by the thermal degradation of Freon 113 and were found to be present in both catalysts after the 90-day test. Author

**N71-33182#** Rocketdyne, Canoga Park, Calif.
**INORGANIC HALOGEN OXIDIZERS Annual Report, 1 Apr. 1970–31 Mar. 1971**
D. Pilipovich, K. O. Christe, C. J. Schack, and R. D. Wilson 1 Jun. 1971 187 p refs
(Contract N00014-70-C-0294)
(AD-724331; R-8725) Avail: NTIS CSCL 7/2

New covalent inorganic perchlorates were prepared from chlorine perchlorate. The compound I(ClO4)3 was partially characterized and N(ClO4)3 deduced as a primary reaction product. CsI(ClO4)4 was synthesized. The action of ClSO3F and I2 produces a variety of iodine fluorosulfates. One partially characterized species is OIF2SO3F. Fluorosulfates of nitrogen could not be made from the reaction of NCl3 and ClSO3F. Neither chlorine perbromate nor chlorine bromate could be isolated from reactions of Cl2O4 with appropriate salts. The reactions of ClSO3F and metal periodates gives IO4SO3F which is apparently a covalent peroxide. Iodyl fluorofulfate and F2 at ambient temperature give SO3F2, IF5O and IF7. The covalent nature of IO2SO3F was supported by the formation of SO3F2. The use of SF4 as a fluorinating agent toward IO2SO3F resulted in the formation of IF5 and S2O5F2. The synthesis of ClO6 could not be effected through the reaction of Cl2O4 and O2AsF6. Based on the nature of the products obtained, a reaction sequence was constructed consistent with the intermediacy of ClO6. The new chlorofluorine of selenium, SeF5Cl, was prepared from CsSeF5 and ClSO3F. Extensive data on SeF5Cl are reported. The study of the reaction of all the chlorine fluorides and HNO3 was completed. No nitrate derivatives of chlorine other than ClNO3 could be formed. Complete vibrational data have been detailed and reported for a number of species, the crystal structure of BrF4+Sb2F11 has been determined. Author (GRA)

**N71-33231*#** IIT Research Inst., Chicago, Ill.
**KINDS AND AMOUNTS OF DECOMPOSITION PRODUCTS IN THE THERMAL DEGRADATION OF SPACECRAFT MATERIALS Final Report, 29 Jun. 1970–28 Jun. 1971**
W. K. Rudloff Jun. 1971 72 p
(Contract NAS9-11090; IITRI Proj. C6221)
(NASA-CR-115096; IITRI-C6221-9) Avail: NTIS CSCL 07D

The thermal degradation profile of 25 selected polymeric spacecraft materials was determined in 100% oxygen at 14.7 psia and 5 psia pressure, as well as in a mixture of 50% oxygen with 50% nitrogen at 5 psia. Also gas chromatography and mass spectrometry were used to obtain qualitative and quantitative analysis of volatile gases and vapors with respect to possible toxic oxidative degradation products. The 25 polymers were selected from five different groups: halocarbons, thermoplastics without nitrogen, nitrogen-containing thermoplastics, thermosetting compounds, and silicones. Bond strength and proximity of certain functional groups in the polymolecules provide a criterion for classification, if toxicity aspects and thermal stability are to be considered. Author

**N71-33277#** Defense Documentation Center, Alexandria, Va.
**RADIATION CHEMISTRY, VOLUME 1 Report Bibliography, Apr. 1960–Nov. 1970**
May 1971 201 p refs
(AD-723940; DDC-TAS-71-19-1-Vol-1) Avail: NTIS CSCL 7/5

The major content of the annotated bibliography is the chemistry of radiation effects on organic, inorganic, and polymeric components. There is also a cross-section of references on instrumentation, and techniques employed in measuring these reactions, and their rates. Author (GRA)

**N71-33388#** Eidgenossische Technische Hochschule, Zurich (Switzerland).
**STUDIES ON THE PARTICLE DENSITY FORMALISM IN QUANTUM CHEMISTRY [UNTERSUCHUNGEN ZUM TEILCHENDICHTE-FORMALISMUS IN DER QUANTENCHEMIE]**
Bruno Hilti (Ph.D. Thesis) 1970 85 p refs In GERMAN Diss. No. 4180
Avail: NTIS

Described is the n-transformation for the spin-dependent particle density field Q(r) and its conjugated P(r) field by square root division. The n-transformation gives a simplified mathematical structure for the two spin-dependent density distribution functions of the n-transformed particle density matrix. The two spin-dependent, n-transformed density distribution functions of the extreme Bardeen-Cooper-Schrieffer singlet wave functions are used to study coherence properties of macro-molecules by obtaining the operator for the particle density representation and by formulating the motion equations for the Q(r) and P(r) fields. Transl. by G.G.

**N71-33414#** Istituto Superiore di Sanita, Rome (Italy). Lab. di Fisica.
**A PMR ANALYSIS OF VARIOUS PRODUCTS OF HYDRATION IN AQUEOUS ACETALDEHYDE MIXTURES**
F. Podo and V. Viti 25 May 1970 24 p refs
(ISS-70/15) Avail: NTIS

By analyzing in high resolution paramagnetic resonance, the aldehydic signal due to hydrated acetaldehyde molecules in water-acetaldehyde solutions, various reaction products were directly detected in neutral and acid environments, in addition to the hydrate 1,1-dihydroxyethane and the hemihydrate 1,1'-oxydiethanol. The formation of the latter compound, already postulated under acid catalysis conditions can explain the nature of one of the reaction products detected in absence of acid as well. A detailed analysis of the signal was carried out under different conditions of temperature, acidity and aging of the samples. Some parallel analyses performed by a mass spectrometer confirms that 1,1'-oxydiethanol is not stable with time under acid catalysis conditions. Additional hypotheses are introduced to give a possible interpretation of the phenomenological data. Author

**N71-33424#** Northeastern Univ., Boston, Mass. Photochemistry and Spectroscopy Lab.
**RESEARCH IN PHOTOCHEMICAL ENERGY CONVERSION Final Report, 1 Oct. 1966–30 Jun. 1970**
Karl Weiss Jan. 1971 264 p refs
(Contract F19628-67-C-0118)
(AD-724374; KW-4; AFCRL-71-0065) Avail: NTIS CSCL 7/5

The results of investigations dealing with the following topics in photochemical energy conversion are presented: Apparatus for Photochemical Studies; Studies of Charge Transfer Systems; The Photochemistry of Perinaphthenone; The Photoreduction of Phenanthrenequinone; Concentration Effects in Photochemical cis-trans Isomerization; Experiments with Singlet Oxygen; The Photochemistry of Nitrogen Heterocyclic and Azo Compounds; Flash Photolysis Studies in Rigid Glasses and in The Solid State; The Photochemistry of Sulfur Compounds; Laser Photochemistry. The report includes ten publications. Author (GRA)

**N71-33436#** Office National d'Etudes et de Recherches Aerospatiales, Paris (France).
**APPLICATION FIELDS FOR AN OIL BASED ON TRIMETHYL PROPANE ESTER [CHAMP D'APPLICATIONS D'UNE HUILE BASEE SUR UN ESTER DU TRIMETHYLOLPROPANE]**
F. Reynaud 1971 14 p refs In FRENCH; ENGLISH summary
(ONERA-TP-930) Avail: NTIS

General considerations of performance increases for lubricating oils based on trimethyl propane ester are examined by their operational capabilities in: (1) a conventional circuit with oil temperatures around 230 C; by adding appropriate additives, it is possible to develop a formula of very satisfactory characteristics; and (2) use at the 380 C level, according to the lost oil principle. The formula appears less well adapted to these new conditions. However the ester remains valid as a base. Author

**N71-33616*#** Peninsula ChemResearch, Inc., Gainesville, Fla.
**HYDROXY TERMINATED PERFLUORO ETHERS Patent Application**
Eugene C. Stump, Jr. and Stephen Eugene Rochow, inventors (to NASA) 11 p Filed 18 Dec. 1970
(Contract NAS7-476)
(NASA-Case-NPO-10768-2; US-Patent-Appl-SN-99524) Avail: NTIS CSCL 07D

Polyurethane resins derived from new hydroxy terminated perfluoro ethers or diols are described. These polyurethane materials possess outstanding chemical resistance with good thermal properties and can be utilized in various space applications, such as potting compounds, coatings, and seals. The resins are formed by the reaction of a diisocyanate with a new diol. The reaction of a diol with a diisocyanate to obtain a polyurethane is conventional, however, based on the fact that the starting diol is a new material, the resulting polyurethane is also new. NASA

**N71-33622#** Council for Scientific and Industrial Research, Pretoria (South Africa).
**BRUCINE: A SENSITIVE REAGENT FOR THE SPECTROPHOTOMETRIC DETERMINATION OF PLATINUM [LA BRUCINE. UN REACTIF SENSIBLE POUR LE DOSAGE PHOTOMETRIQUE DU PLATINE]**
S. K. Nath et al 1969 7 p refs Transl. into ENGLISH from Chim. Anal. (Paris), v. 49, no. 1, 1967 p 38–40
Avail: NTIS

An attempt was made to establish a suitable reagent for the spectrophotometric determination of platinum and iridium. Brucine was found to produce a red color complex with platinum (4+) upon heating, but produces no color reaction with other platinum metals. Results indicate brucine is an extremely sensitive reagent for platinum determination but, no color reaction was observed for iridium. E.H.W.

**N71-33623#** Council for Scientific and Industrial Research, Pretoria (South Africa).
**THE DEPENDENCE ON CONCENTRATION AND TEMPERATURE OF THE SELF DIFFUSION ACTIVATION ENERGY IN AQUEOUS SOLUTIONS OF ELECTROLYTES [KONTSENTRATSIONNAIA I TEMPERATURNAIA ZAVISIMOST ENERGII AKTTVATSII SAMODIFFUZII V VODNYKH RASTVORAKH ELEKTROLITOV]**
A. I. Torianik et al 1969 6 p refs Transl. into ENGLISH from Teor. Eksperim. Khim., Akad. Nauk Ukr. SSR (Kiev), no. 5, 1969 p 411–415
Avail: NTIS

The self diffusion of water molecules in aqueous solutions of NaCl, KCl, KBr, KI, and CsCl was determined in the 5 to 70 deg range using the nuclear magnetic resonance spin echo method. The results show that in the KCl, KBr, KI, and CsCl solutions the increase in self diffusion coefficient which occurred at room temperature, disappeared as the temperature increased; whereas in NaCl solutions, the effect occurred at below room temperature. The activation energy was determined from the dependence of the self diffusion coefficient. The activation energy was also shown as a function of concentration at different temperatures. E.H.W.

**N71-33728*#** Pratt and Whitney Aircraft, West Palm Beach, Fla. Research and Development Center.
**PROPERTIES OF MATERIALS IN HIGH PRESSURE HYDROGEN AT CRYOGENIC, ROOM, AND ELEVATED TEMPERATURES Annual Report**
J. A. Harris, Jr. and M. C. Van Wanderham 30 Jun. 1971 96 p
(Contract NAS8-26191)
(NASA-CR-119884; PWA-FR-4566) Avail: NTIS CSCL 07D

Results of mechanical property tests of nickel, titanium, and iron alloys in 5000 psig gaseous helium and hydrogen at various temperatures, and the comparison of test results to determine degradation of properties due to the hydrogen environment are presented. Author

**N71-33753#** Cincinnati Univ., Ohio.
**VISCOSITY OF ANILINE AND CYCLOHEXANE MIXTURES IN THE CRITICAL REGION**
Charles C. Yang (Ph.D. Thesis) 1970 95 p refs
Avail: NTIS

At low temperature aniline is only partially miscible in cyclohexane and vice versa. Thus if three parts by volume of cyclohexane and two parts of aniline are shaken together, they will separate into two layers, one consisting of cyclohexane with some aniline, the other of aniline with some cyclohexane dissolved in it. As the temperature is raised the compositions of the two layers become closer. This is because the solubility of each liquid in the other increases with increasing temperature. Finally, a temperature is reached at which the two layers have become identical in composition. The interface disappears and the layers can no longer be distinguished from each other. Author

**N71-33807** Tufts Univ., Boston, Mass.
**NUCLEAR DYNAMIC POLARIZATION: INSTRUMENTATION AND INVESTIGATIONS IN FLUORINATED LIQUID HYDROCARBONS**
Michael Reisman Pearlman (Ph.D. Thesis) 1968 163 p
Avail: Univ. Microfilms Order No. 70-17265

Instrumentation for a double resonance helix spectrometer was developed for the study of nuclear dynamic polarization. Design criteria for construction of helices for microwave spectrometers are discussed with particular attention to the large magnetic fields required in double resonance experimentation. Some coil-to-guide matching techniques are evaluated with regard to efficiency, sensitivity, and simplicity. Techniques of coil and match evaluation are discussed in detail. Several nuclear magnetic resonance detection systems are examined with special regard to their compatibility with the microwave helix. Dissert. Abstr.

**N71-33873#** Rocket Propulsion Establishment, Wescott (England).
**THE HETEROGENEOUS DECOMPOSITION OF HYDRAZINE. PART 2: THE USE OF N15 AS A TRACER TO STUDY THE DECOMPOSITION OF HYDRAZINE ON THE SHELL 405 CATALYST**
C F. Sayer Dec. 1969 19 p refs
(RPE-TR-69/10) Avail: NTIS

The origin of nitrogen produced by catalytic decomposition of liquid hydrazine was studied by measuring the distribution of N-15 in nitrogen produced from N-15 enriched hydrazine in a large excess of normal hydrazine. From isotope abundance ratios deduced from mass spectrometric analysis it appears that hydrazine decomposes on the Shell 405 catalyst (iridium on alumina) to give nitrogen in which both atoms come from the same hydrazine molecule. The overall reaction may be represented by 3N2H4 yields N2 + 4NH3 side reactions producing a little hydrogen. Hydrazine hydrochloride decomposes on the same catalyst, without side reactions, in exact accordance with 3N2H5(+) yields N2 + 4NH3 + 3H(+), also without N-N bond fission. Using rhodium as the

catalyst, both hydrazine and hydrazine hydrochloride decompose to give nitrogen molecules, the two atoms of which stem from the same hydrazine molecule, according to the reactions 2N2H4 yields N2 + H2 + 2NH3, and 2N2H5(+) yields N2 + H2 + 2NH3 + 2H(+). Author

**N71-33993#** Bureau of Mines, Washington, D.C.
**BUREAU OF MINES MINERALS YEARBOOK: HELIUM**
Edwin M. Thomasson 1969 6 p
Avail: SOD $0.10

Data are presented concerning the production, consumption, and resources of helium in the U.S., as of 31 Dec. 1969. Most of the data tables include comparative figures for the four preceding years. D.L.G.

# 07 COMMUNICATIONS

Includes communications equipment and techniques; noise; radio and communications blackout; modulation telemetry; tracking radar and optical observation; and wave propagation. For basic research see: 23 Physics, General; and 21 Navigation.

**N71-32807#** Forschungsinstitut fuer Hochfrequenzphysik, Werthhoven (West Germany). Abteilung fuer Fernmeldewesen.
**DAILY AND HOURLY FORECAST OF TROPOSPHERIC PROPAGATION PARAMETERS**
H. J. Albrecht 3 Aug. 1970 26 p refs Presented at the EPP/AGARD Symp. on Tropospheric Radio Wave Propagation, Dusseldorf, Sep. 1970 Sponsored by Min. of Defense
(Rept-8-70) Avail: NTIS

A review is given of propagation parameters predictable by means of the use of meteorological characteristics, which may be determined with a relatively high reliability. The present status of predicting characteristics of communication links using tropospheric radio wave propagation is reported on. ESRO

**N71-32808#** Forschungsinstitut fuer Hochfrequenzphysik, Werthhoven (West Germany). Abteilung fuer Fernmeldewesen.
**SHORT-TERM FORECAST OF SIGNAL BEHAVIOUR WITH TROPOSPHERIC SCATTER LINKS**
D. E. Marquart 3 Aug. 1970 21 p refs Presented at the EPP/AGARD Symp. on Tropospheric Radio Wave Propagation, Dusseldorf, Sep. 1970 Sponsored by Min. of Defense
(Rept-9-70) Avail: NTIS

A statistical method is developed for predicting changes in field strength by means of some meteorological parameters representing the influence of climate as well as seasonal and daily weather conditions. These parameters are to supply the prediction method of the computable "basic transmission loss", considering path geometry. ESRO

**N71-32836** RAND Corp., Santa Monica, Calif.
**SCINTILLATIONS OF RADIO SOURCES**
*In its* Topics in High Energy Astrophys. Based on Lectures by Peter Goldreich at the RAND Corp. during Jun.–Jul. 1969 Nov. 1970 p 17–49 refs (See N71-32836 20-30)
Copyright. Avail: Issuing Activity

The discussion of the amplitude fluctuations of radio sources is based on a short paper by Scheuer which treats the effects of refraction by irregularities in the interstellar medium. Scheuer concluded that only the more slowly varying fluctuations can be attributed to this effect, and that the more rapid variations must be intrinsic to the source. Scheuer presents rough calculations only, and lists other references for the general theory of scattering in irregular media. The literature in this field contains many diverse, often contradictory, views. Comments on the general theory are presented in order to indicate the questionable nature of a number of widely held assumptions concerning wave propagation in random media. Author

**N71-32887** British Broadcasting Corp., Kingswood (England). Research Dept.
**SELECTIVITY OF mf TRANSISTOR PORTABLE RECEIVERS**
M. J. Buckley and J. G. Spencer 1971 10 p refs
(Rept-1971/16) Avail: BBC, Kingswood Warren, Tadworth, Surrey, England

Subjective measurements have been made in the laboratory on ten transistor portable receivers of current and recent type to determine their selectivity on the mf band, and the extent to which they might suffer overloading by strong local signals. The investigation covered frequency spacings between the wanted and interfering transmissions of from 9 kHz to approximately 250 kHz. The majority of the receivers could accept a wanted signal of about 200 mV/m without significant distortion caused by overloading. An unwanted strong signal would not produce noticeable interference in the majority of receivers provided that it was spaced by more than 6% in frequency from the wanted signal and did not exceed 1 V/m in strength. Author

**N71-32888** British Broadcasting Corp., Kingswood (England). Research Dept.
**ACTIVE AERIAL ARRAYS: RECIPROCITY**
1971 6 p refs
(Rept-1971/17) Avail: BBC, Kingswood Warren, Tadworth, Surrey, England

It is shown that the usual Reciprocity Theorem does not hold in general for active aerial arrays. A new formulation of reciprocity is presented which can be applied to active aerials. Author

**N71-32942#** Kiruna Geophysical Observatory (Sweden).
**A TITHERIDGE TYPE POLARIMETER WITH INTEGRATED CIRCUITS**
Sixten Olsson Mar. 1971 23 p refs
(KGO-TR-71-102) Avail: NTIS

A titheridge-type polarimeter for polarization rotation angle measurements from satellite beacon transmissions by means of a rotating antenna and a phase comparator is described. The rotating antenna is connected to the receiver by means of a rotating coil instead of slip rings. By means of the described test transmitter the polarimeter can be calibrated to an accuracy of at least + or − 3 deg. Examples of recordings of the polarization plane from the semigeostationary satellite Intelsat 2F-1 are given. Author (ESRO)

**N71-32954#** IIT Research Inst., Chicago, Ill.
**STUDY OF CONCEPTS FOR NAVY COMMUNICATIONS**
Nicholas T. Thomopoulos, Peter M. McManamon, and Robert V. Janc May 1971 193 p refs
(Contract N00014-70-C-0375)
(AD-724340; IITRI-E6174-8) Avail: NTIS CSCL 17/2

Recent developments indicate improvements might be realized in Naval tactical voice communication nets by considering various alternatives to present signaling and supervisory control techniques and equipment. The objective of this program was to formulate and

develop an analytical model based on queueing theory for the purpose of evaluating possible improvements. The improvements were considered in the framework of (1) Fundamental system alternatives, (2) Singaler function alternatives, (3) Net, personnel and equipment grouping alternatives and (4) Signaling equipment sophistication alternatives. Author (GRA)

**N71-32999#** Lincoln Lab., Mass. Inst. of Tech., Lexington.
**GENERAL PURPOSE DIGITAL SIGNAL PROCESSING ARCHITECTURES FOR RADAR**
B. Gold 16 Apr. 1971 37 p refs
(Contract F19628-70-C-0230; ARPA Order-1559)
(AD-724685; ESD-TR-71-118; TN-1971-22) Avail: NTIS CSCL 17/9

Digital signal processing techniques expand the capabilities of modern radars. The central algorithm of radar signal processing is the fast Fourier transform (FFT). However, each radar has several modes and in most cases, environmental factors such as noise and clutter background are not completely understood. For this reason, flexibility of the signal processor is desirable. A method of gaining this flexibility is via general purpose (i.e., programmable) digital signal processing computer structures. In this note, a variety of such structures, both programmable, yet suitable for high speed FFT, are expanded. Author (GRA)

**N71-33031#** White Sands Missile Range, N.Mex. Tele-Communications Working Group.
**TELEMETRY STANDARDS (REVISED JANUARY 1971)**
1971 116 p revised
(AD-724692; RCC-106-71) Avail: NTIS CSCL 9/6

The standards were established to foster the compatibility of telemetry transmitting, receiving, and signal processing equipment at the test ranges under the cognizance of the members of the Range Commanders Council. To this end, the Range Commanders recommend that telemetry equipment operated at the test ranges, and telemetry equipment used by programs requiring test range support, conform to these standards. Author (GRA)

**N71-33077#** Lincoln Lab., Mass. Inst. of Tech., Lexington.
**A THEORY OF MULTIPLE ANTENNA AMTI RADAR**
E. M. Hofstetter, C. J. Weinstein, and C. E. Muche 8 Apr. 1971 105 p refs
(Contract F19628-70-C-0230; ARPA Order-1559)
(AD-724076; ESD-TR-71-115; TN-1971-21) Avail: NTIS CSCL 17/9

The note presents a detailed mathematical analysis of a multiple-antenna AMTI radar system capable of detecting moving targets over a significantly wider velocity range than is achievable with a single-antenna system. The general system configuration and signaling strategy is defined, and relationships among system and signaling parameters are investigated. A deterministic model for the target return and a statistical model for the clutter and noise returns are obtained, and an optimum processor for target detection is derived. A performance measure applicable to a large class of processors, including the optimum processor, is defined and some of its analytical properties investigated. It is shown that an easily implementable sub-optimum processor, based on two-dimensional spectral analysis, performs nearly as well as the optimum processor. The resolution and ambiguity properties of this sub-optimum processor are studied and a detailed numerical investigation of system performance is presented, including a study of how performance varies with basic system parameters such as the number of antennas. Author (GRA)

**N71-33081#** Texas Univ., Austin. Electronics Research Center.
**PYROMAGNETIC INFRARED RADIATION DETECTORS Annual Report, 1 Jun. 1970 – 31 May 1971**
R. M. Walser and R. W. Bene 31 May 1971 49 p refs
(Contract N00014-67-A-0126-0014)
(AD-724324) Avail: NTIS CSCL 17/5

The report describes progress in investigations of pyromagnetic phenomena, and their application to infrared radiation detection. The characteristics of pyromagnetic radiation detectors, i.e., fast response, broadband, 300K operation, are precisely those required for many important applications in infrared laser research, infrared spectroscopy, remote sensing of infrared emission, and a variety of military problems. Accordingly, the bulk of the research involves the investigation of materials and techniques for pyromagnetic infrared detection. Initial investigations have firmly established the feasibility of the pyromagnetic detection technique. In the technical review that follows an account of the progress made thus far is reported. GRA

**N71-33092#** Air Force Cambridge Research Labs., Bedford, Mass.
**NUMERICAL SOLUTION OF WAVE EQUATIONS FOR LONG WAVELENGTH RADIO WAVES**
Samuel Horowitz 13 Apr. 1971 17 p refs
(AD-724608; AFCRL-71-02) Avail: NTIS CSCL 20/14

The long wavelength reflection coefficients for a day and night horizontally stratified model ionosphere are calculated by integrating the governing differential equations. The wave fields inside the ionosphere and the group height are also illustrated. This is useful when the measured reflection or conversion coefficients show unexpected features and a detailed examination of these wave fields may lead to a physical insight of the origin of such features. The compute time is 200 horizontally stratified slabs per second on a CDC 6600. Author (GRA)

**N71-33107*#** Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
**HIGH PULSE RATE HIGH RESOLUTION OPTICAL RADAR SYSTEM Patent Application**
Willis C. Goss, Richard H. Burns, and K-Chuan Chi, inventors (to NASA) 12 p Filed 13 Nov. 1970
(Contract NAS7-100)
(NASA-Case-NPO-11426; US-Patent-Appl-SN-89210) Avail: NTIS CSCL 20I

A radar transmitting system is disclosed for transmitting an optical pulse to a target. The system comprises an optical cavity with a laser incorporating a mode-locking means to build up an optical pulse. An optical switch is also provided within the cavity. The optical switch comprises an electro-optical crystal driven by a time delayed driver circuit which is triggered by a coincident signal made from an optical pulse signal and a gating pulse signal. Upon being energized, the electro-optical crystal functions to convert the polarization of the optical pulse as it passes through the crystal. This converted optical pulse then strikes a polarization sensitive prism and is deflected out of the cavity toward the pending target in the form of a pulse containing most of the optical energy generated by the laser in the pulse build-up period. After striking the target, the reflected energy is picked up by a transceiver with the total travel time of the pulse being recorded. This travel time is a measure of the distance from the transceiver to the target. NASA

**N71-33108*** National Aeronautics and Space Administration. John F. Kennedy Space Center, Cocoa Beach, Fla.
**PROTECTIVE SUIT HAVING AN AUDIO TRANSCEIVER Patent**
Herbert E. Cribb, inventor (to NASA) Issued 28 Jun. 1971 7 p Filed 11 Dec. 1968
(NASA-Case-KSC-10164; US-Patent-3,588,359; US-Patent-Appl-SN-782955; US-Patent-Class-179:1R; US-Patent-Class-179-1VC) Avail: US Patent Office CSCL 17B

A voice operated receiving and transmitting system for

a wearer of a protective suit is described. The system can be automatically changed from a receiving condition to a transmitting condition responsive to the wearer's voice. The system is provided with a control for regulating the audio level at which the switching operation takes place. Official Gazette of the U.S. Patent Office

N71-33114# Ohio State Univ., Columbus. Disaster Research Center.

**COMMUNICATIONS IN NATURAL DISASTERS**

Robert A. Stallings Jan. 1971 58 p refs

(Contract DAHC20-68-C-0117)

(AD-723993; DRC-Ser-10) Avail: NTIS CSCL 15/3

Field data collected on a sample of twenty-four natural disasters in the United States during the years 1963 through 1970 are analyzed in a summary of communication processes and problems. Communication is defined as a process in which messages are sent from one point to another, while communication structure denotes the patterned relationships among parts linked in this process. Three kinds of communication structures are examined. Internal communication refers to message transmisssion between points within single organizations; interorganizational communication involves messages passing between two or more separate organizations; and public-to-organization communication refers to messages received by groups from a number of individual members of the general public. In the discussions of each of these three types of communication relationships, typical problems encountered in disaster situations are mentioned, the more common ways in which communication capability is increased and demands reduced are outlined, and the most frequent changes in communication patterns initiated following involvement in an actual disaster are described. Author (GRA)

N71-33165# Army Cold Regions Research and Engineering Lab., Hanover, N.H.

**THERMAL INSULATION FOR PROTECTING COMMUNICATIONS CABLES FROM FROST HEAVE DAMAGE [EPLOVAYA IZOLYATZIYA KAK SREDSTVO ZASHCHITY KABELEI SVYAZI OT POVREZHDENIYA PRI PUCHENII GRUNTA]**

Yu. G. Kulikov 1971 8 p refs Transl. into ENGLISH from Tr. Vses. Nauchn. Issled. Inst. Transportnogo Stroitelstva (USSR), V. 57, 1966 p 93-95

(AD-724643; CRREL-TL-270) Avail: NTIS CSCL 9/1

The effect of the thermal insulation or fill varies depending on the climatic and frozen ground conditions as a result of which the optimal dimensions of the insulation will vary somewhat for each region. Author (GRA)

N71-33167*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.

**DEVELOPMENT AND IMPLEMENTATION**

F. L. Singleton, K. Kawano, C. F. Leahey, R. H. Evans, E. L. Yinger et al *In its* The Deep Space Network, Vol. 4 15 Aug. 1971 p 116-177 refs (See N71-33163 20-30)

Avail: NTIS CSCL 17B

The Deep Space Network Space Flight Operations Facility (SFOF) digital television display subassembly and hardcopy equipment are described as well as the Mark 3A simulation center diagnostic software. The Ground Communications Facility (GCF) high-speed data system and implementation for 1971 to 1972 are reported along with the high-speed data assemblies for the GCF deep space station communications equipment subsystem and the GCF-SFOF communications terminal subsystem, and the GCF area communications terminal subsystem high-speed data regeneration assembly. Performance and error statistics at 4800 bps are reviewed for the high-speed data system. The Deep Space Instrumentation Facility (DSIF) developments in the multiple-mission telemetry and command systems are summarized and the computer-controllable phase shifter and data decorder assembly are outlined. J.M.

N71-33172*# Tennessee Univ., Knoxville. Dept. of Physics and Astronomy.

**LINE SHIFTS IN THE FIRST OVERTONE OF DF BROADENED BY HF**

U. G. Desai, N. M. Gailar, and R. J. Lovell 1971 15 p refs

(Grant NGL-43-001-006)

(NASA-CR-121411) Avail: NTIS CSCL 20N

The self-shifts of the lines in the fundamental of HF from P(7) to R(8) and the line shifts in the first overtone band of DF when perturbed by HF were measured from P(7) to R(6). Pressure-induced shifts in the HF fundamental were studied at room temperature and at pressures of HF varying from 37.5 to 113.5 cm Hg. The shifts agreed with those observed by Herget, but the estimated error 0.00005/cm/cm Hg was about one-third of that of Herget. The partial pressures of DF ranged from 5.48 to 22 cm Hg, and total pressure of mixed gases ranged from 36.12 cm to 121.8 cm Hg. Temperatures of reference and sample cells were 110 C, 120 C, 150 C, and 134 C. The shifts oscillate with a period of one in J and with increasing amplitude in the wings from R(1) to R(6) and P(3) to P(7). The direction of the shifts is the same as that found for the DCl-HCl system and is opposite to that predicted by the simple near-resonant dipole theory. The magnitude of the shifts are considerably larger than those found from the DCl-HCl study. Author

N71-33184*# Raytheon Co., Sudbury, Mass. Equipment Div.

**SPACE GEODESY AIRCRAFT EXPERIMENT Final Report**

E. Genest May 1970 268 p refs

(Contract NASw-1932)

(NASA-CR-121379) Avail: NTIS CSCL 17I

Measurements of the radar pulse shape and cross section per unit area at vertical incidence from various ocean conditions were made during the 1969 to 1970 winter approximately 120 miles east of Norfolk, Va. The radar equipment consisted of an X-band transmitter, receiver, and antenna system generating pulses of ten through one hundred nanoseconds. The reflections were received on a high speed oscilloscope inside an aircraft flying at 10,000 feet. Ocean truth was provided: (1) by two cameras located in the aircraft, one of which obtained pictures which were subsequently processed to provide two dimensional Fourier transforms of the ocean surface; (2) by a NASA ship on location which provided measurements of ocean and atmospheric conditions, and; (3) by a second aircraft with a laser profilometer which provided precise measurements of the ocean waves. Author

N71-33185*# Geological Survey, Denver, Colo.

**GEOLOGIC INTERPRETATION OF A RADAR MOSAIC OF YELLOWSTONE NATIONAL PARK**

Harold J. Prostka Feb. 1970 18 p refs

(NASA Order W-12589)

(NASA-CR-121425; Rept-179) Avail: NTIS CSCL 17I

A radar mosaic of the Yellowstone National Park area depicted the topographic and surface textural features of five major rock units and structural features well enough that a fairly accurate generalized geologic map could be drawn. Correct rock units were shown in 70 percent of the area of this interpretive map. Interpretive errors resulted in the areas where diagnostic features were masked by surficial deposits or were modified by glacial scour or young faults. Author

N71-33212*# Geological Survey, Washington, D.C.

**GEOGRAPHIC EVALUATION OF RADAR IMAGERY OF NEW ENGLAND**

Robert B. Simpson (Dartmouth Coll.) Sep. 1969 50 p refs

(NASA Order W-12572; Grant USGS-14-08-0001-G-8)

(NASA-CR-121426; Rept-163) Avail: NTIS CSCL 17I

Certain pre-existing, K-band, dual-polarized radar imagery of New England is evaluated. The capability of radar to reveal the

density and distribution of population through revealing the size, shape and distribution of built-up areas is examined. Limiting factors in interpretation include not only those associated with the radar itself, but also those resulting from the complex clutter of the New England landscape. Assuming that the results are statistically valid it is concluded that radar permits a typical interpreter to find 74% of the populated places of New England, including all cities of over 7,000 population; 80% of the towns having 800 to 7,000 people; and 40% of the hamlets of 150 to 800 people. Signatures in the fields of hydrography, surface configuration, transportation and agricultural land use are discussed briefly. A table is presented for summarizing the confidence level that can be placed on the consistency of selected landscape items to leave signatures. Author

**N71-33280*#** National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
**EVOLUTION OF A SPACECRAFT ANTENNA SYSTEM**
A. Kampinsky Washington Sep. 1971 12 p refs
(NASA-TN-D-6483; G-970) Avail: NTIS CSCL 09E

The mechanically despun antenna has evolved from a simple, rotatable planar reflector to a more sophisticated multi-frequency, attitude-sensing, high gain antenna for deep space (galactic) probes, tactical communications, and community broadcast applications. The spur of this evolution has been the goal of a two to five year lifetime in space environment with simple mechanical mechanisms, low power consumption, high communications gain, and low noise and magnetic spillage. The developmental efforts have yielded precise, pulse-driven motors, instrument bearings, lubrication techniques and high reliability electronic circuits. The proofs of the design concepts are the actual flight experiences of the ATS-3 mechanical antenna system, which, since its November 1967 launch, has performed admirably to date; the Intelsat 3 system antenna system derived from the predecessor reflective antenna design, and the extension to a military, high capacity despun antenna platform system. Author

**N71-33289#** Eidgenossische Technische Hochschule, Zurich (Switerzland).
**ADDRESS ENCODED SYNCHRONOUS MULTIPLEXING METHOD FOR EFFECTIVE TRANSMISSION OF VIDEO SIGNALS [ADDRESSENCODIERTE SYNCHRONE MULTIPLEXVERFAHREN ZUR WIRKSAMEN UEBERTRAGUNG DIGITALER BILDSIGNALE]**
Peter Stucki (Ph.D. Thesis) 1970 102 p refs In GERMAN; ENGLISH summary
(Diss-4516) Avail: NTIS

The transmission of digitally encoded black and white pictures is investigated and the error probability distribution function versus the number of simultaneously transmitted black and white pictures is theoretically derived. The system is simulated on the digital computer in order to determine the maximum number of simultaneously transmittable black and white pictures. It is shown that a reduction of pictorial cross-take is possible by nonlinear filtering and that by nonlinear encoding of the amplitude differences a substantial increase in the transmission efficiency is obtained. The determination of the signal-to-noise ratios and the maximum number of simultaneously transmittable grey-tone pictures as well as the optimization of the system parameters are again obtained by simulation. Author

**N71-33372*#** National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
**ARRAYS OF LARGE APERTURE ANTENNAS: AN EXPERIMENTAL EVALUATION**
Leonard F. Deerkoski Feb. 1971 109 p refs
(NASA-TM-X-65669; X-811-71-40) Avail: NTIS CSCL 09E

The system requirements for arrays of large aperture antennas are presented. Several alternative phasing and weighting techniques are analyzed for their suitability in providing optimum gain improvement for the array over that of the elements. The gain improvement capability of a two element array of large aperture antennas using a phase lock receiver with automatic gain control weighting was measured and found to provide within 0.5 db of the theoretical maximum. These measurements were made at VHF and S-band while tracking spacecraft. A digital time delay compensation system was developed that extends the bandwidth capability of a two element array at up to 2800 feet separation by a factor of 50 times. The time delay compensation system had no detectable effect upon the coherent receiver used for predetection combining. Author

**N71-33379#** Office National d'Etudes et de Recherches Aerospatiales, Paris (France).
**THE A.C.H. SHORT HELICAL ANTENNA AND ITS APPLICATIONS [L'ANTENNE COURTE HELICOIDALE (A.C.H.) ET SES APPLICATIONS]**
Roger Gouillou and Guy Ringenbech 1971 6 p refs Presented at the Conf. sur les Antennes Aerospatiales, London, 8–10 Jun. 1971
(TP-950) Avail: NTIS

The characteristics and applications of the short helical antenna are discussed. The radiation pattern is that of a quarter wave, and its efficiency and bandwidth depend on its dimensions. The influences of a metallic disk and of a tuning capacitor are described, and the bandwidth is defined by the frequencies for a given ratio of radiated to input power. The applications include fixed or vehicle-mounted antennas, spacecraft antennas, and antennas subjected to very high accelerations such as more than 3000 g's. N.E.N.

**N71-33413*#** New Mexico State Univ., Las Cruces. Engineering Experiment Station.
**ADVANCED STUDY OF VIDEO SIGNAL PROCESSING IN LOW SIGNAL TO NOISE ENVIRONMENTS Semiannual Progress Report, Jun. – Nov. 1970**
Frank Carden and Robert Bowden Nov. 1970 40 p refs
(Grant NGR-32-003-037)
(NASA-CR-121433) Avail: NTIS CSCL 20N

The behavior of a bandpass filter in the multi-filter phase lock loop when driven with a sinusoidal drive is investigated. Amplitude jumps which are found in only nonlinear systems, are shown to exist in the multi-filter phase lock loop, providing information to help in understanding the operation of the loop. Author

**N71-33539#** Los Alamos Scientific Lab., N.Mex.
**SCATTERING OF LIGHT FROM A STRATIFIED SPHERE**
B. R. Suydam Feb. 1971 8 p refs
(Contract W-7405-eng-36)
(LA-4642) Avail: NTIS

The scattering theory of Mie is extended to an inhomogeneous sphere. Specifically, the sphere consists of an arbitrary number of concentric shells, to each of which is assigned its own index of refraction, in a general complex. In addition two limiting cases are examined: (1) thin spherical shell; and, (2) the limit of infinitely many shells (an index of refraction which varies continuously with the distance from the center). Author

**N71-33558*#** Massachusetts Inst. of Tech., Cambridge. Center for Space Research.
**PATTERNS OF DIPOLE ANTENNA ON STRATIFIED MEDIUM**

W. W. Cooper Jun. 1971 99 p refs
(Contract NAS9-11540)
(NASA-CR-121413; TR-71-3) Avail: NTIS CSCL 20N

The choice of an antenna for a lunar surface electrical properties experiment depends heavily on the radiation characteristics of the antenna as placed on the surface of a lunar medium. For engineering purposes, it is useful to simplify the model to a Hertzian dipole (x-, y-, or z-directed) on the surface of a planar-stratified medium. A general formulation for the fields in a piece-wise isotropic, stratified medium, with a finite number of layers, is derived using the method of TE and TM decomposition of the fields into transverse-harmonic (plane) waves, without use of any electromagnetic potentials. The medium is further simplified for numerical comparison of dipole characteristics on the surface between two half-space isotropic media. Author

**N71-33606*** Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
**HIGH POWER MICROWAVE POWER DIVIDER Patent**
Richard B. Kolbly, inventor (to NASA) Issued 28 Jun. 1971 5 p Filed 6 Oct. 1969 Sponsored by NASA Supersedes <N70-35629<(08 – 19, p 3499)
(NASA-Case-NPO-11031; US-Patent-3,588,751; US-Patent-Appl-SN-864097; US-Patent-Class-333-6; US-Patent-Class-333-7; US-Patent-Class-333-21A) Avail: US Patent Office CSCL 17B

A microwave power divider is described wherein microwave energy at a fixed rectangular waveguide input terminal is supplied in variable ratios to a pair of rectangular waveguide output ports of a fixed output orthomode transducer. The energy into the rectangular waveguide input terminal is transduced to the TE11 mode in a mode change transducer connected to the input rectangular waveguide. A first quarter-wave plate transduces the energy to a circular polarization mode. A second quarter-wave plate, rotatable with respect to the first quarter-wave plate, tranduces the circularly polarized energy to a rotatable linear polarization mode, the angle of polarization being a function of the rotary setting of the second quarter-wave plate. The orthomode transducer, fixed relative to the input terminal, receives the linear polarized output from the second quarter-wave plate. The power into each port of the orthomode transducer is a function of the polarization angle of the linearly polarized energy. Official Gazette of the U.S. Patent Office

**N71-33613*** Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
**A dc SERVOSYSTEM INCLUDING AN ac MOTOR Patent**
Edmund J. Bahm, inventor (to NASA) Issued 28 Jun. 1971 7 p Filed 9 Jul. 1969 Sponsored by NASA Supersedes N70-12614 (08 – 01, p 0144)
(NASA-Case-NPO-10700; US-Patent-3,588,648; US-Patent-Appl-SN-840308; US-Patent-Class-318-227; US-Patent-Class-318-230) Avail: US Patent Office CSCL 09A

Details are given on a simplified servo system particularly adapted for use in driving variable speed tape aboard spacecraft. The system takes advantage of existing dc motor servo systems by using a dc to ac inverter to drive an ac motor at slow speeds. The instantaneous rate of the motor is detected at a tachometer and converted to an electrical sinusodial signal, which is then delivered through a circuit and a low pass filter to "Venera-4", "Venera-5", "Venera-6", and "Venera-7", signal having an amplitude proportional to the speed of the motor. By employing a current regulator for controlling the amperage through the coils, the flux density of the rotating magnetic field may be varied for controlling the speed of the motor, independently of the position of the rotor, thereby achieving and maintaining smooth torque outputs at low speeds and thus eliminating a need for reduction gear trains and the like. Official Gazette of the U.S. Patent Office

**N71-33687#** Post Office Engineering Dept., London (England).
**TECHNICAL FACTORS IN THE COMMERCIAL USE OF COMMUNICATION SATELLITES**
A. K. Jefferis 1971 7 p Presented at the Brit. Interplanet. Soc. Symp. on Appl. Satellites, Southampton, 14–15 Apr. 1971
Avail: NTIS

The British Post Office is a large user of the Intelsat communications satellite system. This system is used for international telephony, telegraphy, and data transmission and for the relaying of television programs. In the future other commercial applications of communication satellites will arise such as regional and national systems for telephony, data, and television, aeronautical systems and maritime systems. This paper deals only with the use systems, like the present Intelsat system, which provide international fixed services. After discussing the factors which affect the decision on whether to use the satellite medium to meet any particular requirement the paper goes on to discuss the particular technical problems which arise from the point of view of the user. The user of the system is defined for the present purpose as the earth station owner. Author (ESRO)

**N71-33698*** Philco-Ford Corp., Houston, Tex.
**FREQUENCY MODULATION DEMODULATOR THRESHOLD EXTENSION DEVICE Patent**
Frank J. Loch and William M. Conrad, inventors (to NASA) Issued 28 Jun. 1971 8 p Filed 12 Nov. 1969 Sponsored by NASA Supersedes <N70-20743<(08 – 08, p 1408)
(NASA-Case-MSC-12165-1; US-Patent-3,588,705; US-Patent-Appl-SN-875849; US-Patent-Class-325-348; US-Patent-Class-325-347; US-Patent-Class-325-473; US-Patent-Class-325-478; US-Patent-Class-325-480; US-Patent-Class-325-492; US-Patent-Class-329-145; US-Patent-Class-328-164; US-Patent-Class-328-165) Avail: US Patent Office CSCL 17B

The threshold extension device described is connected between the output of a frequency modulation demodulator and the input of the customary demodulator output filter to minimize the occurrence of impulse or click noise at N71-32785 output of the output filter. The device includes a click-eliminating signal transfer channel with a follow and hold circuit. Amplitude-sensitive click detector circuitry detects the occurrence of a click-type noise impulse, and switches the follow and hold circuit to the hold condition. The signal transferred to the output filter is held at the last previous nonclick value during the occurrence of the click impulse. Official Gazette of the U.S. Patent Office

**N71-33710#** Office National d'Etudes et de Recherches Aerospatiales, Paris (France).
**SLOT AERIAL FOR 2300 MHz OMNIDIRECTIONAL RADIATION [ANTENNE A FENTE A RAYONNEMENT OMNIDIRECTIONNEL A 2300 MHz]**
Christian Pouit 1971 6 p Presented at the Conf. sur les Antennes Aerospatiales, London, 8-10 Jun. 1971
(TP-949) Avail: NTIS

A one slot antenna energized by a dielectric waveguide was developed by ONERA. The antenna offers distinct advantages over the usual types as regards the following requirements: (a) space saving, (b) very open radiation pattern and, (c) ability to withstand high temperature and vibration. Measurements of the radiation pattern and calculations show that the radiated power of one antenna is nearly uniformly distributed within a solid angle of 2 pi steradians. This feature was applied for obtaining quasi-omnidirectional transmissions from large and small diameter cylindrical bodies, using only one pair of slot antennas. Author

**N71-33738*#** National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
**ON ELECTRON-CYCLOTRON WAVE RESONANCE IN INDUCTIVELY COUPLED HF DISCHARGES**

Edward P. Szuszczewicz Aug. 1971 23 p refs
(NASA-TM-X-65672; X-625-71-317) Avail: NTIS CSCL 20N

The theory of Pfeiffer on electron-cyclotron wave resonance phenomenon in inductively-coupled HF ring discharges was extended by Sager to include electron temperature, nonuniform density distributions and the finite dimensions of a plasma of rectangular cross section. A scheme is proposed for adapting Sager's results to the experimentally important case of circular cross section. In order to test the scheme, an experiment was conducted in a low-pressure HF (27 MHz) argon discharge of cylindrical geometry with plasma densities in the range $1.0 - 3.5 \times 10$ to the 11th power/cu cm and static magnetic fields less than 60 gauss. The agreement between theory and experiment is found to be good and lends credence to the scheme as a means for predicting resonance values of magnetic field in cylindrical HF discharges. Author

**N71-33788#** National Aviation Facilities Experimental Center, Atlantic City, N.J.

**OPERATIONAL EVALUATION OF THE BRIGHT RADAR MICROWAVE REMOTING SYSTEM Final Report, May 1970 – Feb. 1971**

Enoch H. Wright Sep. 1971 27 p
(FAA-RD-7148; FAA-NA-71-14) Avail: NTIS

An operational evaluation to determine the capability of a bright radar microwave remoting system to provide operationally useful radar data in a satellite control tower was conducted. The microwave equipment consisted of a 15 GHz microwave transmitter and receiver and two 6-foot parabolic antennas. The air traffic control tower used a pre-production model of a BRITE-I display with a 16-inch cathode ray tube (Bright Radar Indicator Tower Equipment) display for the first half of the evaluation and a BRITE-II display for the last half. A daily log was maintained to record any deterioration of display quality and also to record rain and thunderstorm activity. Air traffic control personnel completed questionnaires during and after the study. It was concluded that the bright radar microwave remoting system is capable of providing operationally useful radar information on BRITE-I/BRITE-II displays in a satellite airport tower and that the system was reliable during the rainfall periods. Author

**N71-33797#** Los Alamos Scientific Lab., N.Mex.

**SINGLE AND MULTIPLE FIELD ENABLING SYSTEM FOR TELEVISION DISC RECORDING**

J. H. Calligan Nov. 1970 5 p refs
(Contract W-7405-eng-36)
(LA-4582) Avail: NTIS

The problems of logic, and the solutions thereof, for programming the video disc recorder are discussed. The system is described containing logic circuits to achieve the proper timing and control gates. Author

**N71-33802** Arizona Univ., Tucson.

**A THEORETICAL STUDY OF THE PROPERTIES OF THE EXCITONIC INSULATOR**

Wallace Ray Henson (Ph.D. Thesis) 1970 71 p
Avail: Univ. Microfilms Order No. 70-15423

The superconductive properties of the excitonic insulator are investigated by considering a simple two-band model. A superconductive response to an electromagnetic perturbation is demonstrated by establishing the existance of the Meissner effect. The interband scattering of electrons plays a crucial role in the calculation. By showing that persistent current states exist, the superconductivity notion is supported. These states are characterized as being the states of lowest free energy, subject to the constraints of charge neutrality and finite current flow due to exciton pairs. The self-consistency of the resulting quasi-particle distributions is proven by solving the energy gap equation for all temperatures below the critical temperature. Critical currents are then found which denote the currents at which the excitonic insulator undergoes a first-order phase transition and returns to the normal phase. Dissert. Abstr.

**N71-33809** British Broadcasting Corp., Kingswood (England). Research Dept.

**OPTIMUM PARAMETERS FOR A RF POWER-SPLITTING NETWORK**

R. E. Davies 1971 6 p
(BBC-1971/20; RA-80) Avail: BBC, Kingswood, Warren, Tadworth, Surrey, England

Feeder systems for aerial arrays and networks which share the power between several transmission lines in a given ratio are discussed. Such networks should be designed to have uniform response and input impedance over a band of frequencies, and a well known means of achieving this is the network shown. Each transmission line is a quarter-wave long at some specified centre frequency at which it is not difficult to deduce a relationship between the characteristic impedances of the lines to ensure that the input impedance has the required value. The further requirement for power splitting in a given ratio determines the ratios of the impedances of all but the input transmission line. There still remains one degree of freedom namely, a scaling factor to multiply all the characteristic impedances by. It is shown that the scale factor can be chosen to ensure that the bandwidth of the system is maximum. Author

**N71-33810** British Broadcasting Corp., Kingswood (England). Research Dept.

**MF PROPAGATION: THE BEHAVIOUR OF THE NORMAL IONOSPHERE DURING THE NIGHT AND AT SUNRISE**

P. Knight 1971 16 p refs
(BBC-1971/22; RA-81) Avail: BBC, Kingswood, Warren, Tadworth, Surrey, England

A survey of published electron-density and collision-frequency data for the night-time ionosphere is presented. A set of idealised ionospheric profiles for the night-time and sunrise periods is presented. These are intended for use with a medium-frequency ray-tracing computer program. Author

**N71-33836#** Comision Nacional de Investigaciones Espaciales, Buenos Aires (Argentina).

**EDUCATIONAL TELEVISION VIA SATELLITE: STUDIES OF ANTECEDENTS AND PROJECTS, PRELIMINARY PLAN, VOLUME 1 [TELEVISION EDUCATIVA VIA SATELITE: ESTUDIOS DE ANTECEDENTES Y PROYECTO, PRELIMINAR DE PLAN, TOMO 1]**

1970 85 p refs In SPANISH
Avail: NTIS

The use of satellite television for educational purposes for Argentina is studied. The requirements and advantages of the educational television system are discussed along with the integration of the existing stations. Several TV educational programs that have been developed in other countries are also discussed. Transl. by F.O.S.

**N71-33837#** Comision Nacional de Investigaciones Espaciales, Buenos Aires (Argentina).

**EDUCATION TELEVISION VIA SATELLITE: STUDIES OF ANTECEDENTS AND PROJECTS, PRELIMINARY PLAN, VOLUME 2 [TELEVISION EDUCATIVA VIA SATELITE: ESTUDIOS DE ANTECEDENTES Y PROYECTO, PRELIMINAR DE PLAN, TOMO 2]**

1970 86 p refs In SPANISH
Avail: NTIS

The international aspects, and legalities of educational-satellite television are discussed in terms of protecting the program originator from the broadcasting laws that differ in each nation. The problems of frequency assignment, population distribution, and educational levels are considered for South America, and a preliminary design for a national system for Argentina, which incorporates the existing TV stations is presented. Transl. by F.O.S.

**N71-33894*#** Hughes Aircraft Co., Culver City, Calif.
**TEST AND EVALUATION OF THE SURVEYOR 3 TELEVISION CAMERA RETURNED FROM THE MOON BY APOLLO 12, VOLUME 1**
31 Dec. 1970 313 p refs Sponsored by NASA Prepared for JPL Original Contains Color Illustrations
(Contract JPL-952792)
(NASA-CR-121481) Avail: NTIS HC $6.00/MF $0.95 CSCL 17B

Results are presented of engineering tests of the Surveyor 3 television camera, which resided on the moon for 2-1/2 years before being brought back to earth by the Apollo 12 astronauts. Electric circuits, electrical, mechanical, and optical components and subsystems, the vidicon tube, and a variety of internal materials and surface coatings were examined to determine the effects of lunar exposure. Anomalies and failures uncovered were analyzed. For the most part, the camera parts withstood the extreme environment exceedingly well except where degradation of obsolete parts or suspect components had been anticipated. No significant evidence of cold welding was observed, and the anomalies were largely attributable to causes other than lunar exposure. Very little evidence of micrometeoroid impact was noted. Discoloration of material surface, one of the major effects noted was found to be due to lunar dust contamination and radiation damage. Author

**N71-33895*#** Hughes Aircraft Co., Culver City, Calif.
**TEST AND EVALUATION OF THE SURVEYOR 3 TELEVISION CAMERA RETURNED FROM THE MOON BY APOLLO 12. VOLUME 2: APPENDICES**
31 Dec. 1970 218 p Sponsored by NASA Prepared for JPL Original Contains Color Illustrations
(Contract JPL-952792)
(NASA-CR-121481) Avail: NTIS HC $6.00/MF $0.95 CSCL 17B

Results of evaluations of Surveyor 3 components retrieved by the Apollo 12 astronauts are presented in a series of appendices. Included are: (1) program management considerations; (2) description of lunar environment; (3) description and checkout of electrical test equipment; (4) functional descriptions of chassis A-4, A-5, and A-6; (5) supplementary data on vidicon and its test program; (6) supplementary data on components tests; (7) supplementary data on materials tests; (8) supporting data for surface effects study; and (9) supplementary data on failure analysis. A.L.

**N71-33923*#** Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
**METHOD AND APPARATUS FOR FREQUENCY DIVISION MULTIPLEX COMMUNICATIONS BY DIGITAL PHASE SHIFT OF CARRIER Patent Application**
Lucien A. Couvillon, Jr., inventor (to NASA) 24 p Filed 13 Nov. 1970
(Contract NAS7-100)
(NASA-Case-NPO-11338; US-Patent-Appl-SN-89212) Avail: NTIS CSCL 17B

A PCM frequency-multiplex technique for modulating and combining a plurality of subcarriers, and phase modulating a carrier, entirely with digital circuits was described. The technique provides means in which power allocations may be readily programmed without the need for altering circuit parameters. NASA

**N71-33959** British Broadcasting Corp., Kingswood (England). Research Dept.
**PAL TOLERANCES ANALYSIS; A PROPOSED STRATEGY**
J. W. Head 1971 14 p refs
(BBC-1971/21; PH-75) Avail: BBC, Kingswood, Warren, Tadworth, Surrey, England

Numerical relationships for determining the quantities actually to be transmitted in a color television system are presented. Errors in tolerated quantities of luminance and chromaticity coordinates are deduced from reverse application of numerical formulas. Quantitative estimates of the subjective picture quality in color television transmission are described. Author

**N71-33960** British Broadcasting Corp., Kingswood (England). Research Dept.
**SATELLITE BROADCASTING: CO-CHANNEL PROTECTION RATES FOR FM TELEVISION**
A. Brown 1971 13 p refs
(BBC-1971/19; RA-79) Avail: BBC, Kingswood, Warren, Tadworth, Surrey, England

Some of the parameters required for an f.m. system suitable for direct television broadcasting from a geo-stationary satellite are discussed. Using a system with such parameters, the results of subjective tests on co-channel interference are presented, and a simple formula is derived relating protection ratio and picture impairment grade. Author

**N71-33998#** Defense Documentation Center, Alexandria, Va.
**RADAR AND RADAR DETECTION SYSTEMS, OPTICAL RADAR, VOLUME 1 Report Bibliography, Mar. 1962–Sep. 1970**
May 1971 88 p refs
(AD-723930; DDC-TAS-71-18-1-Vol-1) Avail: NTIS CSCL 17/8

The annotated references in the volume express the use of optical radar techniques, optical devices and techniques, laser applications, optical detection, tracking and scanning, target recognition and discrimination, target acquisition, optical surveillance, and performance evaluation studies. Computer-generated indexes cover corporate author-monitoring agency, subject, title, and personal author. Author (GRA)

# 08 COMPUTERS

Includes computer operation and programming; and data processing. For applications, see specific categories. For related information see also: 19 Mathematics

**N71-32813#** Maryland Univ., College Park. Computer Science Center.
**SHAPE SYNTHESIS, 2**
Emily Johnston and Azriel Rosenfeld Mar. 1971 102 p refs
(Contract F19628-70-C-0208)
(AD-724130; AFCRL-71-0207; SR-3) Avail: NTIS CSCL 6/4

The document is concerned with the computer synthesis of classes of natural shapes and patterns. Computer programs have been written to facilitate the construction of shape outlines and medial axes through interaction with the computer via teletype. These programs have been applied to the synthesis of shape classes such as noses and leaves. Other programs have been written that allow the user to construct approximations to the medial axes of given shapes and to compare the shapes reconstructed from these approximations to the original shapes. Author (GRA)

**N71-32869#** National Physical Lab., Teddington (England). Div. of Numerical Analysis and Computing.

**AN ALGORITHM TO FIND A LOCAL MINIMUM OF AN INDEFINITE QUADRATIC PROGRAM**

W. Murray Jun. 1971 31 p refs Presented at the 7th Symp. on Math. Programming, The Hague, 1970

(NPL-DNAC-1) Copyright. Avail: NTIS

An algorithm is described that will find either the global minimum of a strictly convex quadratic program or a local minimum of an indefinite quadratic program. The algorithm is a generalization of a recently published algorithm for linear programming. A feature of the new algorithm is that numerically stable factors of a matrix are recurred as opposed to its inverse or unstable factors. Author (ESRO)

**N71-32905#** Army Mobility Equipment Research and Development Center, Fort Belvoir, Va.

**HPMPH: A DIGITAL COMPUTER PROGRAM FOR COMPUTER-AIDED DESIGN**

Robert M. McKechnie, III Apr. 1971 40 p

(AD-724622; USAMERDC-2003) Avail: NTIS CSCL 9/2

The report is part of the Electrical Equipment Divisions simulation effort and describes a digital computer graphics program for on-line time-sharing application. This report was written specifically for the USAMERDC electric vehicle program. The program is written in Fortran IV (ASA Standard) and requires minimal teletype input of vehicle data and outputs on XY plot of horsepower-vs-mph for various slopes and surfaces. The output may be an oscilloscope or an analog-type XY plotter. Author (GRA)

**N71-33039#** Academy of Sciences (USSR), Moscow. Inst. for Space Research.

**PROSPECTS OF THE SPACECRAFT ELECTRONICS INTERACTION**

V. V. Andrejanov 1971 18 p

(D-64) Avail: NTIS

The introduction of a spaceborne computer has consequences on the data handling. The role the computer can play in combination with the telemetry equipment and receiving equipment is discussed and possible equipment modifications are suggested. ESRO

**N71-33110*** National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.

**VARIABLE DIGITAL PROCESSOR INCLUDING A REGISTER FOR SHIFTING AND ROTATING BITS IN EITHER DIRECTION Patent**

Robert J. Lesniewski, inventor (to NASA) Issued 28 Jun. 1971 20 p Filed 14 Mar. 1968

(NASA-Case-GSC-10186; US-Patent-3,588,483; US-Patent-Appl-SN-713188; US-Patent-Class-235-175; US-Patent-Class-235-164) Avail: US Patent Office CSCL 09B

A data processor, including a plurality of cascaded registers connected together to selectively perform left and right shifts, as well as right rotation, is described. The register stages are selectively connected to feed and be responsive to a single data line at either end. The register stages are selectively connected in parallel data lines to be responsive for signals on the data lines. Words stored in the register can be combined with words on the parallel data lines in accordance with logical functions such as AND, OR, EXCLUSIVE OR, ADDITION, and SUBTRACTION. The register stages can also combine signals from one of the serial data lines with signals stored there and from the parallel data lines. Official Gazette of the U.S. Patent Office

**N71-33121#** National Physical Lab., Teddington (England). Div. of Computer Science.

**SHAPE ANALYSIS AND CHARACTER RECOGNITION**

Donald A. Bell Mar. 1971 60 p refs

(NPL-COM-SCP-47) Avail: NTIS

After a brief survey of the fields of pattern recognition, picture processing, and reading machines, the Cyclops 3 reader for handwritten numerals is described from the points of view of hardware, computer simulation and decision logic. The development of techniques for designing and implementing decision trees is discussed with emphasis on the graphics facilities and problems associated with the computer aided design aspects. Author (ESRO)

**N71-33132#** RAND Corp., Santa Monica, Calif.

**THE USE OF COMPUTER SYSTEM ACCOUNTING DATA TO MEASURE THE EFFECT OF A SYSTEM MODIFICATION**

R. A. Watson [1970] 16 p

(P-4536-1) Avail: NTIS CSCL 09B

Techniques for reducing and analyzing computer system accounting data used in measuring the effect of a system modification are described. Two different methods are used in analyzing the data, both involving the use of statistical analysis. One method uses regression analysis while the other method uses cluster analysis. Author

**N71-33213#** National Physical Lab., Teddington (England). Div. of Computer Science.

**DIVISION OF COMPUTER SCIENCE Progress Report, Jul. 1969–Feb. 1971**

Apr. 1971 50 p refs

(NPL-COM-SCI-48) Avail: NTIS

Subjects treated are pattern and speech recognition, aided by a graphic input device; man-machine interaction in operating a graphical display programmer and in computer use by inexperienced users; work on information systems, e.g. transcription of Palantype mechanical shorthand to readable English, including programmable error correction; and a fact retrieval system for police use. ESRO

**N71-33318*** National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

**GASP: A COMPUTER CODE FOR CALCULATING THE THERMODYNAMIC AND TRANSPORT PROPERTIES FOR EIGHT FLUIDS: HELIUM, METHANE, NEON, NITROGEN, CARBON MONOXIDE, OXYGEN, ARGON, CARBON DIOXIDE**

R. C. Hendricks, A. Baron, I. Peller, and K. J. Pew 1971 49 p refs Presented at the 13th Intern. Congr. of Refrig., Washington, D. C., 27 Aug.–3 Sep. 1971; Sponsored by the Natl. Acad. of Sci./Natl. Res. Council

(NASA-TM-X-67895; E-6501) Avail: NTIS CSCL 09B

A family of FORTRAN IV subroutines was developed to calculate the thermodynamic and transport properties of eight cryogenic fluids at pressures from 0.1 to 200 atmospheres (to 100 atm for helium) and from the triple point to 300 K for neon; to 500 K for carbon monoxide and oxygen; to 600 K for methane and nitrogen; to 1000 K for argon and carbon dioxide; and from 3 to 500 K for helium. An operations sheet with a detailed description of pertinent input parameters and a discussion of the results was included in the text. A brief description of each subroutine was presented. The master subroutine GASP calculates the remaining state variable when given any two of pressure, density, and temperature as input. In addition, any or all of the thermodynamic and transport properties — enthalpy, entropy, specific heats (Cp, Cv), sonic velocity, thermal conductivity, surface tension — can be obtained. A call to GASP with pressure and enthalpy or entropy as input will also generate the other properties. A special technique was provided to estimate the thermal conductivity near the thermodynamic critical point. Author

N71-33427*# RAND Corp., Santa Monica, Calif.
**COMPUTER PERFORMANCE ANALYSIS: APPLICATIONS OF ACCOUNTING DATA**
R. Watson May 1971 70 p refs
(Contracts NAS12-2144; F44620-67-C-0045; Proj. RAND)
(NASA-CR-121436; R-573-NASA/PR) Avail: NTIS CSCL 09B

The analysis of computer system accounting data as a valuable tool in computer performance analysis was considered. The data available from computer accounting systems and the techniques for conditioning and reducing the data was described. Various applications for using the data in the measurement and evaluation of computer system performance were discussed. The applications of accounting-data analysis that can be performed at low marginal cost were emphasized and it was suggested that Air Force and NASA computer installations take full advantage of such analyses in economizing and/or improving the performance of their computer systems. Author

N71-33551*# Maryland Univ., College Park. Computer Science Center.
**A CRITICAL STATISTIC FOR CHANNELS WITH MEMORY**
J-P. A. Adoul (Sherbrooke Univ.), B. D. Fritchman (Lehigh Univ.), and L. N. Kanal Jun. 1971 41 p refs
(Grants NGL-21-002-008; AF-AFOSR-68-1390B; AF-AFOSR-71-1982)
(NASA-CR-121429; AFOSR-71-1982; TR-161) Avail: NTIS CSCL 09B

A new descriptive statistic for channels with memory is presented and its utility in evaluating and comparing existing models for such channels, and as a theoretical tool in defining the error-gap distribution characteristics of real channels is shown. Certain kinds of real channel behavior cannot be adequately described by previously proposed models and an example of a better model which includes many of the earlier models as special cases is offered. Author

N71-33564*# Maryland Univ., College Park. Computer Science Center.
**ON A PROGRAMMING LANGUAGE FOR GRAPH ALGORITHMS**
Werner C. Rheinboldt, Victor R. Basili, and Charles K. Mesztenyi Jun. 1971 45 p refs
(Grants NGL-21-002-008; NSF GJ-1067)
(NASA-CR-119723; TR-158) Avail: NTIS CSCL 09B

An algorithmic language, GRAAL, is presented for describing and implementing graph algorithms of the type primarily arising in applications. The language is based on a set algebraic model of graph theory which defines the graph structure in terms of morphisms between certain set algebraic structures over the node set and arc set. GRAAL is modular in the sense that the user specifies which of these mappings are available with any graph. This allows flexibility in the selection of the storage representation for different graph structures. In line with its set theoretic foundation, the language introduces sets as a basic data type and provides for the efficient execution of all set and graph operators. At present, GRAAL is defined as an extension of ALGOL 60 and its formal description is given as a supplement to the syntactic and semantic definition of ALGOL. Author

N71-33679*# National Aeronautics and Space Administration, Washington, D.C.
**SPACEBORNE DIGITAL COMPUTER SYSTEMS: SPACE VEHICLE DESIGN CRITERIA**
Mar. 1971 82 p
(NASA-SP-8070) Avail: NTIS CSCL 09B

Spaceborne computer functions, system designs, physical characteristics, environmental design factors, reliability and fault tolerance, and the testing and checkout of computers for guidance and control are reviewed and discussed. Design tradeoffs, and simulation, are included as design criteria for the project manager to use in guiding a design or in assessing its adequacy. Recommended practices and the best procedure are described. J.M.

N71-33698*# RAND Corp., Santa Monica, Calif.
**A STUDY OF USER BEHAVIOR IN PROBLEM SOLVING WITH AN INTERACTIVE COMPUTER**
M. J. Seven, B. W. Boehm, and R. A. Watson Apr. 1971 148 p refs
(Contract NAS12-2144)
(NASA-CR-121480; R-513-NASA) Avail: NTIS CSCL 09B

An exploratory investigation tested the effects of forced temporal lockout intervals on user performance in an interactive man-computer problem solving situation. The subjects having a 5 minute lockout period after each trial not only achieved better solutions to the problem than did the control (no lockout) group, but they also used far less computer time and less total working time. A longer lockout period (8 minutes) appeared to be disruptive, especially for more experienced subjects. Other findings suggest that self-imposed restraint, such as that resulting from a restrictive charge algorithm, can also improve problem solving efficiency, and that the users acceptance of the system is not necessarily a valid predictor of system effectiveness. Author

N71-33889*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
**BINARY CODED SEQUENTIAL ACQUISION RANGING SYSTEM Patent Application**
Warren L. Martin and Richard M. Goldstein, inventors (to NASA) 33 p Filed 13 Aug. 1970
(Contract NAS7-100)
(NASA-Case-NPO-11194; US-Patent-Appl-SN-63532) Avail: NTIS CSCL 09B

A transponder-type ranging systems for accurately determining the distance of a distant object or target was described. The ranging systems used coded ranging signals or components transmitted from a ground station to a target transponder for retransmission to the ground station. The relative phase difference between the transmitted and received coded ranging signals was indicative of the target range. NASA

# 09 ELECTRONIC EQUIPMENT

Includes electronic test equipment and maintainability; component parts, e.g., electron tubes, tunnel diodes, transistors; integrated circuitry; microminiaturization. For basic research see: 10 Electronics. For related information see also: 07 Communications and 21 Navigation.

N71-32908# Army Electronics Command, Fort Monmouth, N.J.
**LOW-POWER HF SYNTHESIZER**
John S. Slechta May 1971 31 p refs
(AD-724602; ECOM-3398) Avail: NTIS CSCL 9/5

The design approach, circuitry, and construction are described for a frequency synthesizer providing 28,000 channels at 1 kHz channel spacing for the HF band. The synthesizer has a battery power drain of 100 mw, which is an order of magnitude less than that of previous designs. Author (GRA)

**N71-32915#** Electronic Communications, Inc., St. Petersburg, Fla.

**EXPLORATORY DEVELOPMENT STUDY MICROELECTRONICS UHF POWER ASSEMBLY Final Report**

Curtis M. Abrahamson and Walter S. Heath 14 May 1971 217 p refs

(Contract N00039-69-C-0561)

(AD-724303) Avail: NTIS CSCL 9/5

The report identifies possible future microelectronic development tasks which will lead to a more optimum RF power assembly which is compatible with monolithic fabrication techniques. Component, circuit technique, mechanical and thermal transfer design requirements are identified which contribute to achieving a small UHF transceiver of 100 to 1000 watts CN in the 225-400 MHz range which is contained in a 40 cu. in. volume. Author (GRA)

**N71-32929#** Rensselaer Research Corp., Troy, N.Y. Electronic Systems Dept.

**BULK SEMICONDUCTOR LIMITERS Quarterly Progress Report, 1 Aug.–31 Oct. 1970**

Albert L. Armstrong, Paul E. Bakeman, Jr., John N. Park, and Wayne C. Taft May 1971 36 p refs

(Contract DAAB07-70-C-0195)

(AD-723980; ECOM-0195-2; QPR-2) Avail: NTIS CSCL 9/1

Emphasis was placed upon the redesign of the silicon limiter element with a view toward increased isolation at high incident power levels and increased maximum power handling capability. The redesign includes new silver-silicon metallization techniques for improved mechanical and thermal properties and the further development of the checkerboard contact for its increased isolation and improved recovery time characteristics. The recovery of the insertion loss to within 3.0 dB of the low level value occurs within 1 usec for limiters with checkerboard contacts in a 2 kW duplexer. This is an improvement by a factor of 5 over the limiters with simple diffused contacts. Other results presented concern gold doping studies and new iris configurations. Author (GRA)

**N71-32939#** Laboratoire d'Automatique et de ses Applications Spatiales, Toulouse (France).

**RESEARCH AND DEVELOPMENT OF AN AUTOMATIC LOGIC INTEGRATED CIRCUIT TESTER [CONCEPTION ET REALISATION D'UN TESTEUR AUTOMATIQUE DE CIRCUITS LOGIQUES INTEGRES]**

Jean-Luc Michelon and Francois Prunet 1970 288 p refs In FRENCH

(LAAS-Publ-747-748) Avail: NTIS

Test equipment for integrated circuitry is discussed. The characteristics of this device are analyzed and the measuring technique described. A detailed computer program is presented. ESRO

**N71-32994#** Lincoln Lab., Mass. Inst. of Tech., Lexington.

**PERFORMANCE OF A 110 WAVELENGTH EHF WAVEGUIDE LENS**

Andre R. Dion 23 Apr. 1971 23 p refs

(Contract F19628-70-C-0230)

(AD-724686; TN-1971-25; ESD-TR-71-119) Avail: NTIS CSCL 9/1

Expanded aluminum honeycomb with a nominal cell width of 0.156 inch was used to fabricate a 24-inch-diameter unzoned lens for operation at 55 GHz. The lens exhibits good focusing properties but its efficiency of only 18 percent reflects significant random phase errors. These errors are shown to result mainly from variations of the cell width. From the measured radiation characteristics the average width of the cells is deduced to be 0.161 inch with a standard deviation of 0.003 inch. Since phase errors associated with variations of the cell width are proportional to the lens thickness it is deduced that the much thinner zoned lenses fabricated from this material would exhibit efficiencies approaching 50 percent. Author (GRA)

**N71-33089#** Army Cold Regions Research and Engineering Lab., Hanover, N.H.

**EFFECT OF FROST HEAVE ON COMMUNICATION CABLES [VLIYANIE MOROZNOGO PUCHENIYA GRUNTOV NA LAKELNYE LINII SVYAZI]**

N. A. Peretrukhin et al 1971 33 p refs Transl. into ENGLISH from Tr. Vses. Nauchn. Issled. Inst. Transportnogo Stroitelstva (USSR), v. 57, 1966 p 28–56

(AD-724636; CRREL-TL-269) Avail: NTIS CSCL 9/1

Frost heave and its effect on cables were studied in experimental sections under natural conditions. The effect of cyclic displacements of the cable on the mechanical and electrical strength was studied under laboratory conditions. Author (GRA)

**N71-33090#** Army Cold Regions Research and Engineering Lab., Hanover, N.H.

**FROST HEAVE DAMAGE TO ELECTRICAL CABLES [AVARII S KABELLAMI OT PUCHENIYA GRUNTA]**

N. P. Smirnov 1971 5 p Transl. into ENGLISH from Elek. Stantsii (USSR), v. 12, no. 7, Apr. 1941 p 31–32

(AD-724635; CRREL-TL-268) Avail: NTIS CSCL 9/1

Repetition of the same type of damage to the cable network has been established in one of the power systems in recent years. Damage has occurred exclusively in the joints, and it has been expressed by pulling of the cable conductors out of the sleeves or clamps. In certain cases, the conductors have been completely pulled out of the sleeve. Pulling has occurred both in cast iron and in lead joints. No external deformations of the lead conduits were observed during pulling in lead joints. In one case, repetition of the same damage on the same cable was noted. The depths of the damaged joints varied within significant limits. All the emergencies had a sharply expressed seasonal nature. The number of emergencies reached the maximum in January and then dropped smoothly to the end of the first half of the year. A special analysis was made of all cases of emergency situations connected with pulling of the cable conductors to discover the causes of the damage. It was found that the cause is heaving of the ground connected with freezing. The process of heaving of the ground and circumstances affecting it are described. Author (GRA)

**N71-33103*#** Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.

**DIGITAL VIDEO DISPLAY SYSTEM USING CATHODE RAY TUBE Patent Application**

Arthur I. Zygielbaum, Warren L. Martin, and Alexander Engel, inventors (to NASA) 70 p Filed 13 Nov. 1970

(Contract NAS7-100)

(NASA-Case-NPO-11342; US-Patent-Appl-SN-89209) Avail: NTIS CSCL 09E

A digital video display system is described for display of image, alpha numeric, and other data on a cathode ray tube with sequential raster scan and programmed spacing of not only rasters but also display elements, and programmed display of elements in 2, 4, or 8 gray shades. This arrangement is called a synchronous asynchronous system for efficient use of memory with a minimum of interruptions of the central processing unit. Interactive manipulation of display data is made feasible. Display at a picture element rate of 4.8 MHz is made possible for display of 40 frames per second, each frame having as many as 80,000 elements. NASA

**N71-33109*** National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.

**PRECISION RECTIFIER WITH FET SWITCHING MEANS Patent**
Gordon J. Deboo and Roger C. Hedlund, inventors (to NASA) Issued 28 Jun. 1971 5 p Filed 24 Jan. 1969
(NASA-Case-ARC-10101-1; US-Patent-3,588,671; US-Patent-Appl-SN-793823; US-Patent-Class-321-47; US-Patent-Class-307-251; US-Patent-Class-307-261) Avail: US Patent Office CSCL 09E

A description is given of a precision full wave rectifier which uses a single operational amplifier. The amplifier is operated simultaneously as a linear amplifier and a switch driver. A pair of FET's are utilized as voltage responsive switches for effecting the rectifying operation, and are gated in response to the output of the operational amplifier. Official Gazette of the U.S. Patent Office

**N71-33119#** Harvard Univ., Cambridge, Mass. Div. of Engineering and Applied Physics.
**THE SHUNT-DRIVEN CIRCULAR LOOP ANTENNA**
Ronold W. P. King Apr. 1971 17 p refs
(Contracts N00014-67-A-0298-0006; N00014-67-A-0298-0005) (AD-724343; TR-821) Avail: NTIS CSCL 9/5

The distribution of current, admittance, and far field of a shunt-driven circular loop antenna are derived and related to those of an equivalent series-driven loop in parallel with a section of transmission line. The effective length of a shunt-loaded receiving antenna is obtained in terms of the corresponding quantity for the series-loaded loop. GRA

**N71-33136#** Pacific Missile Range, Point Mugu, Calif.
**A HIGH-FREQUENCY AMPLIFIER SYNTHESIS PROGRAM. LINVIL COMPUTER FORTRAN 4 PROGRAM PERFORMS NECESSARY COMPUTATIONS PLUS GRAPHIC OUTPUT**
J. A. Means 4 Jun. 1971 55 p refs
(AD-724290; PMR-TP-71-3) Avail: NTIS CSCL 9/5

A FORTRAN IV program called LINVIL has been developed at the Pacific Missile Range, Point Mugu, California, for the purpose of designing high-frequency amplifiers. The input data supplied by the engineer include the four complex parameters of the Y-, Z-, G-, H-, F-, Script F-, or S-type, center frequency, bandwidth, sensitivity, and the source and load resistances. The computer printout furnishes the maximum available gain, the maximum gain compatible with the sensitivity requirement, the network stability factor (Linvills C factor), the complex value of load admittance, the complex value of source admittance, the parallel RLC element values required as a load to realize the bandwidth, and the element values (L and C) required to match, at the operating frequency, the complex load and source admittances to the desired load and source resistances. This report includes a brief review of the Linvill technique, examples of various designs with various input data, guides for the user, and a complete FORTRAN IV listing. Author (GRA)

**N71-33137#** Boeing Scientific Research Labs., Seattle, Wash. Plasma Physics Lab.
**WIDE-BAND HOT-CARRIER DIODE GATE WITH APPLICATION TO ELECTRON-HOLE PLASMAS**
R. M. Lantz, W. P. Robbins, H. J. Fossum, and B. Ancker-Johnson Sep. 1970 20 p refs
(AD-713602; D1-82-0998) Avail: NTIS CSCL 9/5

A sampling or tone-burst gating system using hot-carrier diodes was designed and shown to have the following characteristics: bend width, dc to 1 GHz; rise and fall times typically = or < 3 nsec and 5 nsec; power capacity about 100 mW; gating pulse frequency 10 Hz to 1 MHz; gating pulse width 50 nsec to 5 nsec; leakage > 45 db down at 100 kHz and about 24 db down at 500 MHz; gate isolation from common ground reference > 80 db at all frequencies; input and output impedances adjustable to match source and load. As this gating system consists of two identical gates in parallel, it presents a constant impedance to prevent undesirable loading perturbations of the rf source. The gate can be synchronized with an rf signal whose frequency is = or < 1 GHz and with the described design changes, may be synchronized with about 10 GHz signal. Author (GRA)

**N71-33190#** Army Electronics Command, Fort Monmouth, N.J.
**APPLICATIONS STUDY, DISCRETE ELEMENT DISPLAY**
Charles H. Browne May 1971 41 p refs
(AD-724603; ECOM-3398) Avail: NTIS CSCL 9/5

The report describes the findings of a study of a discrete element magneto-optic display. The magneto-optic display is an electronically controllable diffraction grating which, by controlling the orientation of the grating at selected points, diffracts light toward an observer. The magneto-optic display device was first evaluated and then used as a research tool for further work in the magneto-optic display area. The remainder of the investigation was concerned with the optical, electronic, and memory aspects of the magneto-optic display. Author (GRA)

**N71-33191#** Air Force Cambridge Research Labs., Bedford, Mass.
**THE SHORT-BACKFIRE ANTENNA AS AN ELEMENT FOR HIGH-GAIN ARRAYS: PHYSICAL SCIENCES RESEARCH PAPERS**
Hermann W. Ehrenspeck and John A. Strom 13 Apr. 1971 17 p refs
(AD-724607; AFCRL-71-0234; AFCRL-PSRP-451) Avail: NTIS CSCL 9/5

The short backfire (SBF) antenna consisting of a large reflector illuminated by a dipole feed and smaller disk reflector produces a gain of 15 dB above isotropic. As an array element it has been effciently adapted for various configurations of high-gain antennas producing gains of up to 25 dB, with a single SBF element capable of replacing four to six elements of a conventional multidipole array. Farfield patterns and directivity measurements are presented for a single element and for a twin element mounted on a common reflector. Optimized dimensions for both cases are discussed for possible application to more complex types of antennas. Author (GRA)

**N71-33420#** Toulouse Univ. (France).
**CONTRIBUTION TO THE STUDY ON THERMAL BEHAVIOR AND FABRICATION ROUTES FOR BIPOLAR TRANSISTORS**
Jean-Pierre Daubonne (M.S. Thesis) 23 Apr. 1971 166 p refs In FRENCH
Avail: NTIS

Mathematical models are formulated for the physical interactions and constraints acting on thermal and electrical properties of bipolar transistors. Model parameter constants are independent of polarization effects and represent characteristic functions of forming technology and fabrication processes for determining quality control parameters during production. Transl. by G.G.

**N71-33421#** Eidgenossische Technische Hochschule, Zurich (Switzerland).
**CONTROL OF BEAM CURRENT AND FOCAL PLANE FOR HIGH POWER ELECTRON BEAM [REGELUNG DES STRAHLSTROMES UND DER FOKUSLAGE EINES HOCHLEISTUNGSELEKTRONENSTRAHLES]**
Ahmed Abdel Latif (Ph.D. Thesis) 1970 119 p refs In GERMAN *Its* Diss. No. 4477
Avail: NTIS

Cathode heating capacity is used as reference control for the electron beam of a discharge cathode. Thyristors provide the necessary power for shock heating in electron guns. Z-stabilization

of the focal point requires additional intermediate imaging of the crossover and is obtained by centering the focal point below the sonde space. Improved X-Y-Z stabilization is obtained by a separation of the individual magnetic circles. Double X-Y diffraction provides planar corrections through crossover eccentricity as well as by beam axis tilt. Transl. by G.G.

**N71-33519*** National Aeronautics and Space Administration. Electronics Research Center, Cambridge, Mass.
**PLASMA FLUIDIC HYBRID DISPLAY Patent**
Edwin H. Hilborn, inventor (to NASA) Issued 28 Jun. 1971 8 p Filed 11 Oct. 1968
(NASA-Case-ERC-10100; US-Patent-3,588,874; US-Patent-Appl-SN-766697; US-Patent-Class-340-324; US-Patent-Class-313-109.5; US-Patent-Class-313-231; US-Patent-Class-315-108; US-Patent-Class-315-111; US-Patent-Class-340-336) Avail: US Patent Office CSCL 09E

A plasma-fluidic hybrid display system combining the desirable high brightness and inherent memory characteristics of plasma display devices, such as neon tubes, with the equally desirable reliability and memory characteristics of fluidic logic devices, such as pure fluid amplifiers with no moving parts, is described. The system comprises an array of plasma cells, an electrical source for energizing the array, a fluid pressure source for pressurizing, and a fluidic logic circuit connected to each cell. A fluidic circuit changes the pressure within each cell and permits or suppresses ionization within selected cells.
Official Gazette of the U.S. Patent Office

**N71-33691*#** National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
**PERFORMANCE OF A DIRECT CURRENT POWER SUPPLY FOR THE 2- TO 15-KILOWATT BRAYTON CYCLE SYSTEM**
James E. Vrancik Washington Aug. 1971 16 p refs
(NASA-TM-X-2349; E-6332) Avail: NTIS CSCL 10B

Performance characteristics of a Brayton cycle dc power supply were determined. The dc supply is a transformer rectifier set that supplies + or − 28 volts dc to a dc bus and + or − 42 volts dc for battery charging. The maximum output power is 1400 watts. The supply was tested over a range of input voltages and frequencies and a range of output current. The efficiency was 89 percent at the design point and the power factor was 0.89 for all tests. The output voltage was approximately a linear function of the input voltage and had a load regulation of 6 percent. The overall performance of the dc supply was judged satisfactory.
Author

**N71-33724#** Office National d'Etudes et de Recherches Aerospatiales, Paris (France).
**SHORT TERM FREQUENCY STABILITY AND SPECTRALS PURITY OF OSCILLATORS [STABILITE DE FREQUENCE A COURT TERME ET PURETE SPECTRALE DES OSCILLATEURS]**
Jacques Rutman (Ph.D. Thesis — Paris Univ.) 1970 92 p refs In FRENCH; ENGLISH summary
(ONERA-Publ-132) Avail: NTIS

The problem of noise in oscillators is reviewed, particularly in terms of the experimental and theoretical characterization of the quality of oscillators perturbed by stationary noise. The two main aspects of this problem, namely frequency instability and spectral purity, are precisely defined. The problem is unified by drawing a number of relationships between these two aspects. An exact study is made of the very short term frequency instability of an oscillator perturbed by thermal noise (computation of a thermodynamical limit). Author

**N71-33774** Washington Univ., Seattle.
**THE MINIMUM TIME REGULATOR PROBLEM FOR PULSE FREQUENCY MODULATED CONTROL SYSTEMS**
Robert Joseph Hynes (Ph.D. Thesis) 1969 217 p
Avail: Univ. Microfilms Order No. 70-14766

The minimum-time regulator problem for PFM control systems was studied. Because of the constrained control set, it was shown that this system is not completely controllable; therefore, it was necessary to pose the problem in terms of controlling to a target set. No general method existed for solving this problem. By studying the solutions of two similar but less constrained problems (the discrete-time minimum-time regulator problem and the continuous-time minimum-time PFM regulator problem was hypothesized. This solution was based on the PFM optimal strategy reducing to the continuous-time optimal strategy as the pulse on-time T sub p goes to 0 (holding the pulse magnitude constant). For second order systems with real nonpositive poles the optimal PFM strategy was demonstrated. The modified maximum principle of Onyshko was developed from another viewpoint. A theory for sampled-data systems with a reset-time in the control element was also developed. Dissert. Abstr.

# 10 ELECTRONICS

Includes circuit theory; and feedback and control theory. For applications see: 09 Electronic Equipment. For related information see specific Physics categories.

**N71-32903#** Aeronautical Research Labs., Melbourne (Australia).
**THE PHASE-SENSITIVE TECHNIQUE IN EDDY CURRENT TESTING**
I. G. Scott Sep. 1970 23 p refs
(ARL-MR-82) Avail: NTIS

An analytical examination was made of errors arising from the use of the phase-sensitive (demodulator) technique in eddy current testing. A simplified treatment of the technique was developed based on a constant current circuit arrangement. A bridge circuit was employed for a practical approach to the problem.
J.G.M.

**N71-33105*#** Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
**DATA AIDED CARRIER TRACKING LOOPS Patent Application**
William C. Lindsey and Marvin K. Simon, inventors (to NASA) 15 p Filed 24 Dec. 1970
(Contract NAS7-100)
(NASA-Case-NPO-11232; US-Patent-Appl-SN-101354) Avail: NTIS CSCL 09C

The loop signal to noise ratio is improved in a phase locked loop used for tracking a carrier in an angle (phase or frequency) modulated communications system. The system is improved by a quadrature channel added to the phase locked loop. A dc signal derived from the quadrature channel is added to the signal feed back to the voltage controlled oscillator in the otherwise conventional phase locked loop. NASA

**N71-33129*** Collins Radio Co., Cedar Rapids, Iowa.
**POWER RESPONSIVE OVERLOAD SENSING CIRCUIT Patent**
Arthur P. Kubicz, inventor (to NASA) Issued 15 Jun. 1971 8 p Filed 1 Aug. 1968 Sponsored by NASA
(NASA-Case-GSC-10667-1; US-Patent-3,585,514; US-Patent-Appl-SN-749548; US-Patent-Class-330-11; US-Patent-Class-330-24; US-Patent-Class-330-16) Avail: US Patent Office CSCL 09C

A power responsive overload sensing circuit capable of substantially instantaneous sensing of and reaction to power overloads is described. The circuit can be used for the protection of a wide range of active devices including solid state devices, vacuum tubes, motors, generators, and others. This relatively simple inexpensive power overload protection circuit is expected to find application in computer power systems.

Official Gazette of the U.S. Patent Office

**N71-33214*#** Ohio State Univ., Columbus. ElectroScience Lab.

**ADAPTIVE OPTIMIZATION OF SIGNAL TO NOISE RATIO IN RECEIVING ARRAYS**

Robert L. Riegler Washington NASA Aug. 1971 119 p refs (Grant NGL-36-008-138)

(NASA-CR-1178; TR-2902-1) Avail: NTIS CSCL 09C

The adaptive optimization of signal-to-noise ratio in receiving arrays is discussed. Both background sky noise and coherent noise interference are considered. The array weighting coefficients which maximize SNR are derived for any array subjected to uniform background antenna noise. An array model of half-wavelength dipoles over a ground plane is analyzed to show the effects of mutual coupling. An adaptive array that rejects undesired or interfering signals is presented. The array pattern is controlled by an adaptive feedback system based on a steepest-descent minimization of mean square error. Error is defined as the difference between the array output and a locally generated reference signal. Minimization of mean square error is closely related to maximization of signal-to-noise ratio. An experimental version, a 2-element S-band adaptive array, is discussed. Typical antenna patterns for various desired and interfering signals are shown, as well as measured transient response. Some experiments showing the array behavior with modulated signals are described. The results show that such an antenna system is capable of automatically rejecting interfering signals, subject only to certain basic constraints. No a priori information concerning the angles of arrival of the signals is required. Detailed knowledge of waveforms of the desired and interfering signals is also not needed, although the spectral density of the desired signal must be known. Author

**N71-33217#** RAND Corp., Santa Monica, Calif.

**INTRINSIC OSCILLATIONS IN NEURAL NETWORKS: A LINEAR MODEL FOR THE nth-ORDER LOOP**

R. J. MacGregor Feb. 1971 44 p refs

(R-642-RC) Avail: NTIS

A theoretical map for the characteristic modes of neuroelectric oscillation in an arbitrary number (n) of nerve cells arranged in a single closed loop is presented, using a linear model with time lag. Generally, there are n possible damped (or rising) oscillatory states for every 2pi range of frequency, in addition to possible nonoscillating solutions. Usually, higher frequencies of oscillation correspond to faster decay rates among characteristic states. A tentative linking of the properties of a loop's oscillations to the physical characteristics of its nerve cells is also presented. It is suggested that the so-called characteristic states of a given subsystem might be envisioned collectively as a repertoire of intrinsic dynamic modes available to the system and could provide a means whereby the properties of the entire network interrelate to achieve its subjective or behavioral function. Author

**N71-33282#** Eidgenossische Technische Hochschule, Zurich (Switzerland).

**MULTIPACTOR EFFECT OF SECONDARY ELECTRONS [PENDELVERVIELFACHUNG VON SEKUNDAERELEKTRONEN]**

Beat Bischof (Ph.D. Thesis) 1970 103 p refs In GERMAN; ENGLISH summary

(DISS-4449) Avail: NTIS

Multipactoring occurs under certain conditions in a cavity. This multipactoring current due to electron multiplication on the cavity walls grows very rapidly. Because this current is a heavy load on the RF generator, it is sometimes impossible to reach the operating voltage. By using the theory of parallel resonant circuit with time depending current load, the equations for the cavity voltage are developed and conditions are derived which allow the prediction of the needed RF power for overcoming this effect by driving the electrons out of the multipactor region. A residual gas analyzer is used to show that the surfaces are cleaned by electron bombardment and that the secondary coefficient diminishes. Author

**N71-33407*** Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.

**ENCODER/DECODER SYSTEM FOR A RAPIDLY SYNCHRONIZABLE BINARY CODE Patent**

Tage O. Anderson and Jack J. Stiffler, inventors (to NASA) Issued 28 Jun. 1971 11 p Filed 9 Feb. 1968 Sponsored by NASA

(NASA-Case-NPO-10343; US-Patent-3,588,883; US-Patent-Appl-SN-704446; US-Patent-Class-340-347DD; US-Patent-Class-178-69.5; US-Patent-Class-179-15BS) Avail: US Patent Office CSCL 09C

An encoder/decoder system designed to generate a binary code which is a function of the outputs of a plurality of bistable elements is described. The generated code is assumed to be transmitted to and received by a receiving unit, where a replica code is generated. Circuit diagrams and operational procedures are presented. Author

**N71-33582#** Council for Scientific and Industrial Research, Pretoria (South Africa).

**DETERMINATION OF THE OPTIMUM RLC CIRCUIT LIMITING THE VOLTAGE GAIN BETWEEN THE TERMINALS OF BLOCKED THYRISTORS [DETERMINATION DU CIRCUIT RLC OPTIMAL LIMITANT LA CROISSANCE DE TENSION AUX BORNES DE THYRISTORS BLOQUES]**

J. M. Nolf 1969 23 p ref Transl. into ENGLISH from Rev. MBLE (Brussels), v. 11, no. 1, 1968 p 13-23

Avail: NTIS

In order to protect thyristors in the non-conducting state against excessive voltage gains between anode and cathode which might lead to abnormal conduction, the provision of an RLC circuit at the input of the circuit containing the thyristors is recommended. Particular attention is given to interlock of the voltage source as a cause of abnormal conduction. Formulae are derived describing the excess voltages developing under such conditions as a function of the parameters of the RLC circuit. Author

**N71-33813#** Brookhaven National Lab., Upton, N.Y.

**TAMING THE WILD FERRITE: A PROPOSAL FOR STABILIZING THE NEW AGS FERRITE CAVITIES**

G. Rakowsky and A. Tranis 11 Mar. 1971 15 p refs

(BNL-15722) Avail: NTIS

In the course of developing the new accelerating cavities for the AGS conversion, it has been necessary to study in detail the non-linearities inherent in ferrite materials. It has been shown that the dependence of effective permeability on the amplitude of RF flux density, coupled with a high Q, may result in instability of the RF cavity. The new ferrite rings, and in fact, the new prototype cavity of the AGS conversion project, exhibit the predicted instability. The theory is reviewed (present data on the characteristics of the new Philips 4L2 ferrite being employed), and the predicted behavior of the new cavities is described. It is shown that the instability can be suppressed by shunting the ferrite cavity with an appropriate damping resistance. Coincidentally, this damping resistance can serve a second useful purpose, namely to level

the RF input power and allow a good match to the transmission line over the band of operation. The synthesis of the damping network is presented and a practical realization is proposed.
Author (NSA)

**N71-33893#** Eidgenossische Technische Hochschule, Zurich (Switzerland).
**RESEARCH ON STATIC AND PULSE NOISE IMMUNITY OF INTEGRATED DIGITAL CIRCUITS**
Abel-Latif Mahmoud Abdel-Latif (Ph.D. Thesis) 1970 156 p refs
(Diss-4470) Avail: NTIS

Noise immunity and noise generation of high speed logic integrated circuits is discussed. As these high-speed digital circuits become more common in military, industrial anf mainly in computer applications, noise control becomes an important problem in order to increase system reliability. A large portion of this concern is due to the decrease in overall system size made possible by integrated technology. Signal lines have been brought into closer proximity to one another, as well as to power-supply lines and system ground lines. Also coupled with the new packaging restrictions of monolithic integrated digital circuits has been an advance in the speed obtainable with transistor switching circuitary.
Author

**N71-33941#** Royal Radar Establishment, Malvern (England).
**RRE NEWSLETTER AND RESEARCH REVIEW, NO. 10**
1971 174 p refs
Avail: NTIS

Various studies on microwave generation by solid state devices are reported and the development of a InP three level electron oscillator is outlined. Work on gallium arsenide transferred electron devices continues. An acoustic surface wave pulse compression filter for sidelobe suppression is described. Also reported are studies on point defects in semiconductors, laser melting of single crystals, growth of doped epitaxial silicon, statistics of laser radiation, and solid state microwave radar systems.
G.G.

# 11 FACILITIES, RESEARCH AND SUPPORT

**Includes airports; lunar and planetary bases including associated vehicles; ground support systems; related logistics; simulators; test facilities (e.g., rocket engine test stands, shock tubes, and wind tunnels); test ranges; and tracking stations.**

**N71-32890#** Army Construction Engineering Research Lab., Champaign, Ill.
**AIRFIELD PAVEMENT SYSTEMS Final Report**
E. Lile Murphree, Jr., Ronald W. Woodhead, and Robert H. Wortman Apr. 1971 24 p refs Presented at the Am. Society of Civil Eng. Natl. Meeting on Transportation, Boston, 13 - 17 Jul. 1970
(AD-724132; CERL-TM-P-1) Avail: NTIS CSCL 1/5

The current airfield pavement design procedures were introduced nearly thirty years ago. At that time, structural support problems had a dominant effect on design procedures. When other requirements were considered in the design process, they were treated in an ad-hoc manner as difficulties arose. With the arrival of the jumbo jets, the importance of the pavement to the air transport system is apparent. The aerospace industry predicts 5 times the passenger miles and 10 to 20 times the cargo tonnage by 1985 as today. Airplanes are expected to be twice the size and weight of those currently flying. The demands of these large, heavy, high performance aircraft will be more rigorous than those of today and a new and comprehensive look at the pavements role is needed. The systems approach holds the key to an integrated plan for design, construction, operation, and maintenance of airfield pavements.
Author (GRA)

**N71-32957#** Von Karman Inst. for Fluid Dynamics, Rhode Saint-Genese (Belgium).
**PERFORMANCE EXPERIMENTS IN THE VKI PISTON DRIVEN SHOCK TUBE**
M. J. Lewis and J. Smith May 1971 28 p refs Sponsored in part by Roy. Soc., London
(VKI-TN-69) Avail: NTIS

Measurements in the 38 mm diameter Von Karman Institute piston driven shock tube, using helium as driver gas and argon as test gas, are described. The piston compression process is investigated by measuring driver gas pressure variation. Shock Mach numbers varying from 11 up to 31 are obtained. Thermodynamic state of the shocked test gas is investigated.
Author (ESRO)

**N71-33007#** Naval Civil Engineering Lab., Port Hueneme, Calif.
**AIRFIELD PAVEMENT CONDITION SURVEY, USNAS NEW ORLEANS, LOUISIANA**
David J. Lambiotte and Robert B. Brownie Apr. 1971 81 p ref
(AD-724286; NCEL-TN-1166) Avail: NTIS CSCL 1/5

The results of a condition survey of the airfield pavements at the U. S. Naval Air Station, New Orleans, Louisiana are presented. The survey established statistically-based condition numbers (weighted defect densities) which were direct indicators of the condition of the individual asphaltic concrete and portland cement concrete pavement facilities. Additional evaluation efforts included photographic coverage of defect types, preparation of the construction history of the station, compilation of data on current aircraft traffic and aircraft types using the station, performance of runway skid resistance tests, and a study of the requirements for future pavement evaluation efforts.
Author (GRA)

**N71-33079#** Naval Civil Engineering Lab., Port Hueneme, Calif.
**AIRFIELD PAVEMENT CONDITION SURVEY, USNAS CHASE FIELD, TEXAS**
D. J. Lambiotte and R. B. Brownie Apr. 1971 99 p ref
(AD-724676; NCEL-TN-1168) Avail: NTIS CSCL 1/5

The results of a condition survey of the airfield pavements at the U. S. Naval Air Station, Chase Field, Texas are presented. The survey established statistically-based condition numbers (weighted defect densities) which were direct indicators of the condition of the individual asphaltic concrete and portland cement concrete pavement facilities. Additional evaluation efforts included photographic coverage of defect types, preparation of the construction history of the station, compilation of data on current aircraft traffic and aircraft types using the station, performance of runway skid resistance tests, and a study of the requirements for future pavement evaluation efforts.
Author (GRA)

**N71-33093#** Army Engineer Waterways Experiment Station, Vicksburg, Miss.
**CONDITION SURVEY, LIBBY ARMY AIRFIELD, FORT HUACHUCA, ARIZONA**
P. J. Vedros Apr. 1971 24 p
(AD-724069; AEWES-MISC-PAPER-S-71-11) Avail: NTIS CSCL 1/5

The purpose of this report is to present the results of an investigation performed at Libby Army Airfield (LAAF) in September

1970. The inspection was limited to visual observations, and no tests were conducted on the existing runways and taxiways. A layout of the airfield is shown. Author (GRA)

**N71-33186#** Chicago Univ., Ill. Dept. of the Geophysical Sciences.
**DETAILS OF THE DESIGN AND CONSTRUCTION OF THE CLOUD PHYSICS LABORATORY'S WIND TUNNEL**
Al Rodi and Paul Spyers-Duran 25 Mar. 1971 38 p refs
(Grants NSF GA-20470; NSF GA-11088)
(TN-37) Avail: NTIS

Efforts to build a wind tunnel suitable as a tool to develop and evaluate meteorological sensors and hydrometer sampling probes were summarized. The considerations which went into the design of each section of the tunnel were discussed, and the results of some recent investigations into aircraft instrumentation were reported. Author

**N71-33218#** Sydney Univ. (Australia). Dept. of Aeronautical Engineering.
**DEVELOPMENT OF A FREE PISTON SHOCK TUBE**
J. Curtis Mar. 1969 75 p refs *Its* Aero. Tech. Note 6901
Avail: NTIS

An economical solution to the problem of providing a high performance shock tube for demonstration work and research is described. The free-piston shock tube was found to be ideally suited for use. The design and production of the tube are described and the methods used to overcome a number of associated practical problems explained. Performance measurements for both the free-piston compressor and the system operated as a shock tube are presented, and the procedures used to obtain them described. Author

**N71-33224#** Naval Civil Engineering Lab., Port Hueneme, Calif.
**AIRFIELD PAVEMENT CONDITION SURVEY, USNAS CUBI POINT, PHILIPPINES**
Hisao Tomita and Robert B. Brownie Apr. 1971 65 p
(AD-724675; NCEL-TN-1167) Avail: NTIS CSCL 1/5

The results of a condition survey of the airfield pavements at the U. S. Naval Air Station, Cubi Point, Philippines are presented. The survey established statistically-based condition numbers (weighted defect densities) which were direct indicators of the condition of the individual asphaltic concrete and portland cement concrete pavement facilities. Additional evaluation efforts included photographic coverage of defect types, preparation of the construction history of the station, compilation of data on current aircraft traffic and aircraft types using the station, and a study of the requirements for future pavement evaluation efforts. Author (GRA)

**N71-33279#** Stevens Inst. of Tech., Hoboken, N.J. Davidson Lab.
**ANALYSIS OF WHEEL PERFORMANCE (AT ZERO SLIP RATE) USING THE WHEEL SOIL SYSTEM CONSTANT Final Report**
Freddie George Smith Apr. 1971 135 p refs
(Contract DAAE07-69-C-0356)
(AD-724151; SIT-DL-71-1529) Avail: NTIS CSCL 13/6

A series of tests were conducted for driven rigid wheels on soft sand. The tests were performed at both positive and negative slip rates. For each slip rate the wheel load, the wheel sinkage, the input driving torque and the drawbar pull were measured. The system constant, is a combination of wheel dimensions and soil parameters, which can be used to develop methods for comparing the performance of various wheels. Theoretically, wheels which are designed and built with the same system constant should possess the same wheel performance parameters; that is, they should sink to the same relative sinkage, support the same total weight and require the same tangential force in order to develop the same drawbar pull. Wheels with different system constants can be compared by normalizing their wheel performance parameters; that is, dividing the actual performance parameter by the value of that wheels system constant. Thus all the performance parameters may be reduced to a common base for easy comparison. Wheel performance prediction equations were developed based on Bekkers pressure sinkage relationship. These equations give good results when compared with the actual experimental test measurements. Author (GRA)

**N71-33310*#** Ohio State Univ. Research Foundation, Columbus. Dept. of Geodetic Science.
**INVESTIGATIONS OF CRITICAL CONFIGURATIONS FOR FUNDAMENTAL RANGE NETWORKS**
Georges Blaha (Ph.D. Thesis) Mar. 1971 285 p refs
(Grant NGL-36-008-093; Proj. OSURF-2514)
(NASA-CR-121445; Rept-150) Avail: NTIS CSCL 14B

Critical configurations are investigated with ground stations lying all in a plane and with ground stations generally distributed. The two kinds of problems require different mathematical treatment and lead to quite different conclusions. A typical critical configuration when all ground stations are in a plane arises when they all lie on one second order curve. When ground stations are generally distributed a typical critical configuration may be represented by all points of a network (ground stations and targets) lying on one second order surface. If these and some other more complex distributions of points are avoided, an adjustment of range networks yields a unique solution. Author

**N71-33340#** Geodetic Inst., Helsinki (Finland).
**THE FINNISH EARTH TIDE STATIONS**
Pentti Groehn *In* Belg. Roy. Obs. 6th Intern. Symp. on Terrest. Tides 1970 p 37–38 refs (See N71-33333 20-13)
Avail: NTIS

A short description of the Finnish earth tide stations is given including equipment used, results gained, and prospects for future work. ESRO

**N71-33341#** International Latitude Obs., Mizusawa (Japan). Geodetic Section.
**OBSERVATIONS OF EARTH TIDES IN MIZUSAWA**
Chikara Sugawa, and Kennosuke Hosoyama *In* Belg. Roy. Obs. 6th Intern. Symp. on Terrest. Tides 1970 p 39–41 See N71-33333 20-13)
Avail: NTIS

A description of the observation station and observing equipment at the International Latitude Observatory of Mizusawa (Japan) is given and some results discussed. ESRO

**N71-33533#** Oak Ridge National Lab., Tenn.
**FUNCTION OF CONDENSING STEAM IN AEROSOL SCRUBBERS**
R. J. Davis and R. J. Truitt Mar. 1971 161 p refs
(Contract W-7405-eng-26)
(ORNL-4654) Avail: NTIS

Information is provided for designing a particle scrubber which would efficiently and cheaply remove very fine (0.2 to 2 micron) particles from polluted air streams. The basic concept was to grow these fine particles up to a size which could be readily separated in a cyclone or other inertial device. The tiny particles would first be grown by steam condensation, then further grown by turbulent agglomeration. A literature study was made to show that the 0.2 to 2 micron particles do represent a critical air

pollution problem area and to show that the scrubber concept is theoretically reasonable. Experiments were done in a simple, vertical pipe, water-cooled condenser into the bottom of which aerosol plus steam was fed. The aerosol concentration and particle size distributions were measured with and without steam addition for a variety of aerosols and steam condensation rates. The results suggest that the concept is valid. Author (NSA)

**N71-33536#** Union Carbide Corp., Oak Ridge, Tenn. Y-12 Plant.
**PRACTICAL LOW-RANGE MOISTURE GENERATOR**
R. F. Wolny 5 May 1971 20 p refs
(Contract W-7405-eng-26)
(Y-1791) Avail: NTIS

Development of a low range moisture generator using magnesium perchlorate tetrahydrate is described for utilization in laboratory and field calibration operations. Requirements for such a generator include: (1) a constant moisture output; (2) a sufficient moist gas flow rate; (3) theoretically acceptable operation; (4) relatively inexpensive and simple constriction; and (5) simple controls. Temperature and pressure controls were added to an existing generator to provide moisture values < 2 to 1000 ppm-v. To prepare the hydrate system, a measured amount of anhydrous magnesium perchlorate is exposed to 40 – 50% relative humidity for three or four days, after which the product is bottled and stored after the desired weight increase has been obtained. A linear relation between the logarithm of water vapor pressure, and the inverse temperature was verified experimentally. Intercept and slope values were found for moisture data, with and without correct from a National Bureau of Standards calibration. The effect of increases in pressure and sample flow rate was also observed at three temperatures, and reasonable agreement with expected results was noted. A.C.R.

**N71-33555*#** National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
**PERFORMANCE OF A NEW VACUUM PACKAGE TO REDUCE TRITIUM CONTAMINATION FOR A 150 KILOVOLT NEUTRON GENERATOR**
Robert Steinberg and Donald L. Alger [1971] 11 p refs Presented at Tritium Symp., Las Vegas, Nev., 30 Aug. – 2 Sep. 1971; sponsored by the Southwestern Radiological Health Lab. Environ. Protection Agency and Nev. Univ.
(NASA-TM-X-67919) Avail: NTIS CSCL 14B

A new vacuum package incorporating a titanium bulk sublimator/ion pump combination has been designed, built, and installed on a typical 150 kilovolt neutron generator. The sublimator/ion pump system provides the following operating advantages: (1) most of the tritium released from the target during deuteron bombardment is permanently buried in the sublimator chamber walls as titanium tritide; (2) a routine pump-down time of 30 minutes from atmosphere to 10 to the minus 7th power torr is obtained; (3) the vacuum system is able to handle large active gas loads because of its high pumping capacity; (4) neutron generator operating pressure may be varied between 10 to the minus 7th power torr and 0.00001 torr by adjusting rate of sublimation. Author

**N71-33557*#** Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
**TRACKING AND DATA SYSTEM SUPPORT FOR THE PIONEER PROJECT. VOLUME 9: PIONEERS 6 -9. EXTENDED MISSIONS, 1 JULY 1969 - 1 JULY 1970**
N. A. Renzetti 15 Aug. 1971 310 p *refs*
(Contract NAS7-100)
(NASA-CR-121383; JPL-TM-33-426-Vol-9) Avail: NTIS CSCL 14B

The tracking and data system supported the deep space phases of the Pioneer 6, 7, 8, and 9 missions, with two spacecraft in an inward trajectory and two spacecraft in an outward trajectory from the earth in heliocentric orbits. During the period of this report, scientific instruments aboard each of the spacecraft continued to register information relative to interplanetary particles and fields, and radio metric data generated by the network continued to improve the knowledge of the celestial mechanics of the solar system. In addition to network support activity detail, network performance and special support activities are covered. Author

**N71-33589#** California Univ., Berkeley. Lawrence Radiation Lab
**ULTRA-NARROW, HIGH-QUALITY, HIGH-FIELD QUADRUPOLE MAGNET**
Robert T. Avery and Jack T. Tanabe Feb. 1971 2 p refs Presented at the Natl. Particle Accelerator Conf., Chicago, 1 Mar. 1971
(Contract W-7405-eng-48)
(UCRL-20164; CONF-710308-13) Avail: NTIS

An ultra-narrow, high-quality quadrupole magnet has been designed for use in the bevatron experimental area. Several magnets have been fabricated and tested. This narrow magnet permits significant improvement in beam target utilization by permitting more beam lines and/or moving closer to the target to achieve greater particle acceptance. In spite of its small size, the magnet can achieve field gradients up to 5000 G/in. The measured field quality generally equals or betters that of full-size quads, which is surprising considering the ultra-narrow width and the simple hyperbolic pole shape. A compact cooling circuit arrangement contributed to achievement of these results within such a small volume. Author (NSA)

**N71-33612*** National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
**WIND TUNNEL MODEL DAMPER Patent**
Max B. Bryan, inventor (to NASA) Issued 28 Jun. 1971 8 p Filed 6 Nov. 1969 Supersedes <N70-22273<(08 – 09, p 1618)
(NASA-Case-XLA-09480; US-Patent-3,587,306; US-Patent-Appl-SN-874435; US-Patent-Class-73-147) Avail: US Patent Office CSCL 14B

A damper system to alleviate some of the unsteady load forces normally experience on a wind tunnel model and its balances during sudden starting and shutdown of high speed wind tunnels is described. During the starting and stopping phases of high speed wind tunnels, for example, in the supersonic and hypersonic speed ranges, a state of unsteady flow exists in the test section. This unsteady flow induces undesirable oscillating aerodynamic loads on the test model that greatly exceed the load limits of the strain gage balances used to measure the steady state model forces and moments. Official Gazette of the U.S. Patent Office

**N71-33615#** Department of Supply, Melbourne (Australia). Aeronautical Research Labs.
**SONIC PRESSURE DISTRIBUTIONS ON 12 PER CENT THICK POLYNOMIAL AEROFOILS IN SLOTTED AND CHOKED WIND TUNNEL TEST SECTIONS**
G. R. Kittson Aug. 1970 39 p refs *Its* Aeron. Note 324
Avail: NTIS

Measurements were made at sonic and near sonic speeds and at zero and near zero angles of attack for each airfoil located symmetrically in a rectangular wind tunnel test section. Two slotted wall arrangements with open area ratios 0.10 and 0.17 were used, and a third arrangement with solid walls provided choked flow. Pressures along the test section walls were measured. The blockage ratios were 1.0%, 1.7%, 2.4%, and 3.0%. The effects of variation in Mach number, angle of attack, spanwise displacement, and leading edge roughness bands were investigated for the normal and reversed airfoil orientations having maximum thickness at 0.7 and

0.3 of chord, respectively. Even at the highest blockage ratio the wall interference is small. Pressure distributions considered to be free of interference are derived. For the profile with maximum thickness at 0.7 of chord, the results are in good agreement with values calculated by the local linearization or the parametric differentiation methods. For the profile with maximum thickness at 0.3 of chord, the present results confirm the prediction of the parametric differentiation method that the pressure gradient beyond 0.5 of chord becomes zero and then positive. Author

**N71-33708#** California Univ., Berkeley. Lawrence Radiation Lab.
**CYROGENIC PUMPING SYSTEM PROPOSED FOR THE BEVATRON**
F. S. Reinath, R. M. Richter, J. T. Tanabe, and E. Zajec Feb. 1971 4 p refs Presented at Natl. Part. Accel. Conf., Chicago, 1 Mar. 1971
(Contract W-7405-eng-48)
(UCRL-20197; Conf-710308-19) Avail: NTIS

A cryogenic pumping system capable of pumping 300,000 l/sec of nitrogen is proposed for the bevatron to decrease the base pressure from approximately 2 × 10 to the minus 6th power to approximately 2 × to the minus 7th power torr. The bevatron consists of approximately 10,000 cu ft of free volume with approximately 15,00 sq ft of free outgassing area. The magnet pole tips, which consists of 1/2 in. laminations, add a potential 80,000 sq ft of outgassing area. The design calls for an approximately 360 ft long 20 K surface shielded by an 80 K surface strung along the inside perimeter of the bevatron. Initial design considerations indicate that radiant heat flux from the 80 K surface is a prime design factor which could greatly affect the operating and installation costs of 80 K refrigeration. A two-dimensional Monte Carlo type program was devised and used to optimize designs with maximum nitrogen pumping speed and minimum 80 K shield area to reduce the refrigeration costs. Author (NSA)

**N71-33742#** Los Alamos Scientific Lab., N.Mex.
**A PROPOSAL FOR EPICS: A HIGH RESOLUTION PION BEAM AND SPECTROMETER FACILITY FOR NUCLEAR STRUCTURE RESEARCH AT LAMPF**
H. A. Thiessen and S. Sobottka, comps. Sep. 1970 43 p refs
(Contract W-7405-eng-36)
(LA-4534) Avail: NTIS

The complete EPICS system consists of a high intensity, high resolution pion beam channel, a particle separator for reducing backgrounds, and two spectrometers. The system may be constructed in two stages. The first stage will consist of the channel, separator, and low momentum spectrometer. At the completion of this stage many of the proposed experiments can be performed including elastic and inelastic pion scattering and the study of those two particle final state reactions for which one particle can be detected in a total absorption detector such as a sodium iodide counter or a Ge(Li) detector. Addition of a high momentum spectrometer will complete the second stage. This spectrometer will allow the study of reactions having a high momentum particle in the final state, as well as several having two-particle final states. Specifications and performance data are given, and the proposed experimental program is summarized. NSA

**N71-33771*#** National Aeronautics and Space Administration. John F. Kennedy Space Center, Cocoa Beach, Fla.
**THE KENNEDY SPACE CENTER STORY**
1 Jun. 1970 239 p
(NASA-TM-X-67274) Avail: NTIS CSCL 14B

The history, origins, and development of the Cape Kennedy Launch Complex are discussed. Subjects presented are:(1) growth of the center, (2) space craft launching, (3) support facilities, and (4) management of the complex. Summaries of various Apollo missions are included. Author

**N71-33880#** Institut fuer Angewandte Geodaesie, Frankfurt Am Main (West Germany).
**SCALING CONTROL BY GEODIMETER NASM-2A FOR THE WEST GERMAN PART OF THE EUROPEAN MAIN TRIANGULATION NET FROM 1958 TO 1968 [DIE MASSSTABSKONTROLLEN MIT DEM GEODIMETER NASM-2A IM WESTDEUTSCHEN ANTEIL DES EUROPAEISCHEN HAUPTDREIECKSNETZES VON 1958 BIS 1968]**
Hansdieter Grosse 1970 44 p refs In GERMAN
(Rept-150) Avail: NTIS

The results of the geodimeter-2A measurements made in the West-German part of the European first-order triangulation net in the years of 1958 to 1968 are presented. The computation of the measured results has been based on calibration values published in No. 149 of this series. Author

**N71-33888*#** Rocketdyne, Canoga Park, Calif.
**OBSERVATION WINDOW FOR A GAS CONFINING CHAMBER Patent Application**
James R. Baughman, Robert Spies, and Lance G. Hays, inventors (to NASA) 16 p Filed 21 Dec. 1970
(Contract NAS7-391)
(NASA-Case-NPO-10890; US-Patent-Appl-SN-99903) Avail: NTIS CSCL 14B

An observation window for viewing the contents of a sealed casing of the type used in conducting streams of a fluid medium, such as saturated steam, is described. The window is characterized by a body having an internal chamber in direct communication with the internal portions of the casing, a transparent closure of a substantially planar configuration, and a heater coil within which the body is confined. Gas delivered from the casing to the chamber is heated by the coil, thus establishing within the chamber a cell of unsaturated gas isolating the transparent closure from the fluid medium. NASA

**N71-33889#** California Univ., Livermore. Lawrence Radiation Lab.
**NEW BEVATRON POLE FACE WINDINGS POWER SYSTEM**
L. T. Jackson Feb. 1971 2 p Presented at the Natl. Particle Accelerator Conf, Chicago, 21 Mar. 1971
(Contract W-7405-eng-48)
(UCRL-2019; Conf-710308-8) Avail: NTIS

The new power systems which individually drive each of the Bevatron pole-face windings must handle a variety of operating parameters as well as satisfying the stringent specification of dI/dt < or = 14 A/sec during flattop. The 19 pole-face windings, which run circumferentially around the machine, each constitutes an active load for their power system, with B voltages increasing with radius up to 190 V during rectification on the outermost winding. During flattop there is approximately 10 V pp of predominately 720 and 1440 Hz signals across the winding. The 0.5 ohms windings require up to +30 A during injection and + or − 100 A during flattop. To satisfy the above requirements, a transistor actuator was chosen utilizing 2N3902 high-voltage transistors. A dc supply with multiple taps on the transformer provides output voltages from 12 V to 270 V to allow matching to each pole-face winding with a voltage higher than the B voltage of that winding so the difference appearing across the actuator is correct for transistor operation. Author (NSA)

**N71-33899#** California Univ., Berkeley. Lawrence Radiation Lab.
**BEVATRON GUIDE FIELD CONTROL**
Don M. Evans, Robert Frias, and Barney Hordos Mar. 1971 4 p refs Presented at the Natl. Particle Accelerator Conf., Chicago, 1 Mar. 1971
(Contract W-7405-eng-48)
(UCRL-20189; Conf-710308-18) Avail: NTIS

The Bevatron guide field power supply was under computer control for one year. This facility allows operational parameters to be programmed at operator request in order to provide the desired field profiles commensurate with the current experimental program. With a requirement of one part in fifteen thousand accuracy for resonant extraction, the digital system was enlarged until a real-time closed-loop control function can meet this specification. A one gauss window for entry into flat-zones is now maintained, while a relative flatness tolerance of + or − 1/2 gauss is held during the typical 2-sec flat-zone. The structure of a new data-acquisition system is described with emphasis upon the use of a fast magnetic-core memory to gather blocks of data, as well as to hold the necessary digital threshold values to be arithmetically compared with the results of the data gathering facility. Also covered, is the implementation of the system in the detection and ultimate reduction if incipient fault conditions within the guide field power supply. Author (NSA)

**N71-33900#** California Univ., Berkeley. Lawrence Radiation Lab.
**DIGITAL CONTROL OF BEVATRON ACCELERATION CYCLE**
Don M. Evans and Fred H. G. Lothrop Feb. 1971 5 p Presented at the Natl. Particle Accelerator Conf., Chicago, 1 Mar. 1971
(Contract W-7405-eng-48)
(UCRL-20185; Conf-710308-15) Avail: NTIS

Control of the Bevatron acceleration system was entirely analog until developments in proton extraction techniques required substantial reduction of hum and noise during the acceleration cycle. The decision was made to employ a digital processor to control the acceleration cycle. An algorithm is developed which allows introduction of radial-feedback data into the digital processor and the real-time error signal is combined with arbitrary field dependent functions for transmission to the existing master oscillator. A high common-mode rejection digital system is utilized to enter the resultant control data directly into the master oscillator environment before conversion into the required analog reference for frequency modulation. A comprehensive hardware calculator provides a continuous curve of digital representations to be sent along to the oscillator. The implementation of these facilities and the development of an operator-oriented interface to capitalize upon the flexibilities inherent within a digitally oriented system are described. Author (NSA)

**N71-33935#** California Univ., Berkeley. Lawrence Radiation Lab.
**ERA 4 MeV INJECTOR**
R. Avery, G. Behrsing, W. W. Chupp, A. Faltens, E. C. Hartwig et al Feb. 1971 5 p refs Presented at the Natl. Particle Accelerator Conf., Chicago, 1 Mar. 1971
(Contract W-7405-eng-48)
(UCRL-20174; Conf-710308-14) Avail: NTIS

A pulsed electron accelerator which was constructed and is now in operation is described. It was designed specifically for and is used as an injector for ERA (electron ring accelerator) studies. Electron bursts of 1200 amperes and 40 nanoseconds duration can be produced at energies of 1.0 to 4.25 MeV. The present repetition rate is approximately one per second. Acceleration is accomplished by means of ferrite loaded accelerating sections, each of which is capable of maintaining a 250 kV voltage pulse across the accelerating gap for a period of 40 ns. The voltage pulse has a rise time of 12 ns and the total timing jitter is of the order of one nanosecond. Five sections stacked together and operated as a unit function as the electron gun. The gun employs a field emission cathode and is operated at approximately 1 MV. Additional acceleration is achieved by means of an iterated system of accelerator sections and solenoidal magnetic lenses. Author (NSA)

**N71-33965#** California Univ., Berkeley. Lawrence Radiation Lab.
**PRELIMINARY HARDWARE CONCEPTS FOR A HIGH ENERGY ELECTRON RING ACCELERATOR**
A. Faltens, E. Hartwig, D. Keefe, and W. Salsig Feb. 1971 4 p refs Presented at Natl. Particle Accelerator Conf., Chicago, 1 Mar. 1971
(Contract W-7405-eng-48)
(UCRL-20169; Conf-710308-17) Avail: NTIS

Results of the first study of the conceptual design of a collective-effect proton accelerator of substantial energy (65 to 100 GeV) are described. Basic theoretical considerations are outlined and components and their arrangement for a conceptual accelerator are discussed. This first study shows that the promise of the ERA principle to produce remarkable compact accelerators can be achieved by use of single-pulse surge-excited acceleration cavities. The example single-pass maching provides accelerating gradients of 250 MeV/meter overall where conventional synchrotrons yield 40 to 80 MeV/meter. The relaxed tolerances of the surge-excited cavities and their associated components allow great advantage to be taken of mass-production techniques with ensuing low cost (0.24M$/GeV). Author (GRA)

**N71-33992#** National Aeronautical Establishment, Ottawa (Ontario).
**ANALYSIS OF THE SUBSONIC WALL INTERFERENCE EFFECTS IN A TWO DIMENSIONAL PERFORATED WALL WIND TUNNEL**
M. Morky Jun. 1970 48 p refs
(LTR-HA-5) Avail: NTIS CSCL 14B

The analytical method presented extends the classical linearized theory of the two dimensional subsonic interference in the perforated wind tunnel up to the perturbation terms of the second order. A doublet on the y-axis, in addition to the source, vortex, and the x-axis double, appeared in the analysis as a logical consequence of the generalized treatment of the problem. By virtue of this singularity it was possible to employ also the pitching moment as a quantity from which the interference directly arises, and thus improve the correction of test data on cambered airfoils. From expressions for the interference factors and the correction formulas it can be concluded that the corrections to stream quantities involve terms of order C/H and (C/H) squared, and corrections to force and moment coefficients involve terms of order C/H, (C/H) squared, and (C/H) cubed. Author

# 12 FLUID MECHANICS

Includes boundary-layer flow; compressible flow; gas dynamics; hydrodynamics; and turbulence. For related information see also: 01 Aerodynamics; and 33 Thermodynamics and Combustion.

**N71-32856#** Alabama Univ., Huntsville. Div. of Graduate Studies and Research.
**RESEARCH AND DEVELOPMENT FLUIDIC CONTROL CONCEPTS AND DESIGNS, PART 1 Final Technical Report, 1 Dec. 1969 – 31 Dec. 1970**
Cornelius C. Shih, Roy W. Blanton, Jerome J. Brainerd, John W. Yarbrough, and Byron J. Schrick Mar. 1971 174 p refs
(Contract DAAH01-70-C-0342)
(AD-724128) Avail: NTIS CSCL 13/7

Analysis of the flow field within a supersonic fluidic amplifier. A numerical evaluation of the flow in a three-dimensional supersonic fluidic amplifier; An experimental investigation of velocity fields in a bistable liquid amplifier using laser doppler instrumentation; The switching of supersonic fluidic amplifiers; Investigation of flow fields in a supersonic fluidic amplifier due to amplifier staging; Parametric analysis of secondary injection for the thrust vector control and application of holographic tech-

niques for the flow visualization; Investigation of effects of reaction jets for the missile attitude control; Feasibility study of velocity measurements in solid propellant rocket exhaust; Investigation of performance and flow characteristics of an ejector control system; Heat transfer relationships for a wedge-shaped-hot-film anemometer in supersonic flow. GRA

N71-32859# Alabama Univ., Huntsville. Div. of Graduate Studies and Research.

**RESEARCH AND DEVELOPMENT FLUIDIC CONTROL CONCEPTS AND DESIGNS, PART 2 Final Technical Report, 1 Dec. 1969 – 31 Dec. 1970**

Cornelius C. Shih, Phillip Mongette, Larry Marshall, John B. Duggan, and Joseph E. Durham Mar. 1971 187 p refs

(Contract DAAH01-70-C-0342)

(AD-724127) Avail: NTIS CSCL 13/7

Much work has been done in investigating the effects of secondary injection into a supersonic flow field for a flat plate and two-dimensional nozzle. For actual application, however, it is in the concial rocket nozzle where the most interest lies. Several variables can affect the resulting side force from secondary injection. There are: flow rate of secondary injectant, sonic or supersonic injection, location of injection port, injection pressure and angle of injection. To investigate the effect of all of these variables at the same time would be quite difficult. 9It was therefore decided to begin with only a few of these variables: flow rate of secondary injectant, location of injection port and sonic condition for the injectant. The nozzle used for the data presented in this report is shown. Each time a larger flow rate was desired for a specific location, the hole was simply drilled larger. Likewise, each time a new location was desired, the previous hole was filled and the new hole size and location was drilled. The limitations of this method are obvious. Only so many holes can be drilled safely in a nozzle of this size. Three locations were tested along with two port sizes for each location. Author (GRA)

N71-32872# Imperial Coll. of Science and Technology, London (England). Dept. of Mechanical Engineering.

**PREDICTION OF A TURBULENT DUCT FLOW WITH SIGNIFICANT RADIATION**

F. C. Lockwood and D. B. Spalding 1971 6 p refs Presented at the Soc. Franc. Phys. Thermodyn. Colloq., Evian, France, 25 – 29 May 1971

(CCK/TN/A/6) Avail: NTIS

A method is presented for predicting a confined, turbulent, axisymmetrical duct flow in which a diffusion flame occurs. Radiation is important and a model is developed for its prediction which is incorporated into an existing solution procedure for the convective and diffusive transfers of momentum, heat and matter. Author

N71-32902# Aeronautical Research Labs., Melbourne (Australia).

**AN EXPERIMENTAL AND NUMERICAL STUDY OF HYPERSONIC FLOW OVER A SPHERICALLY BLUNTED 18 DEGREE SEMI-ANGLE CONE**

I. A. Campbell Sep. 1970 21 p refs

(ARL-AN-328) Avail: NTIS

Surface pressure distributions and shock shapes were measured on a sperically blunted cone, semi-angle 18 degrees, at M = 7.5. Experimental values show good agreement with the inviscid solution after due allowance for boundary layer displacement effects. Although cone pressures in certain regions were less than sharp cone pressures, the overall drag coefficient of the blunted cone never fell below the sharp cone value. Author

N71-32956# Von Karman Inst. for Fluid Dynamics, Rhode Saint-Genese (Belgium).

**TECHNIQUES FOR MEASURING THE THERMODYNAMIC PROPERTIES OF A DENSE GAS**

M. J. Lewis, B. P. Roman, and G. Rouel May 1971 38 p refs Presented at the IEEEE 4th Intern. Congr. on Instr. in Aerospace Simulation Facilities, Rhode St-Genese, Belg., Jun. 1971 Sponsored in part by NSF

(VKI-TM-23) Avail: NTIS

Techniques are described for measuring the transient pressure, temperature, and density of a dense, high-temperature gas. These techniques involve new applications of a sodium spectral line reversal system and a contactless eddy current displacement transducer. Data are presented for dense nitrogen, produced by means of a piston compression process, with pressures up to 2200 kg/sq cm, temperatures to 1960 K and densities to 200 amagats. Uncertainties in these measured data are considered to be less than three percent. Author (ESRO)

N71-32971# Naval Undersea Research and Development Center, San Diego, Calif.

**DRAG REDUCTION OF FLAT PLATES WITH SURFACE ROUGHNESS**

Michael Poreh Apr. 1971 49 p refs

(AD-724288; NUC-TP-222) Avail: NTIS CSCL 20/4

The effect on drag reduction of the surface roughness of flat plates was studied. The plates are considered first to be moving in homogeneous polymer solutions and next to be ejecting polymers. It is shown that when the roughness is small relative to the thickness of the viscous sublayer near a smooth surface, the effect of the roughness is also small and can be neglected, whereas larger roughness reduces the effect of the polymers drastically. Author (GRA)

N71-33001# Office National d'Etudes et de Recherches Aerospatiales, Paris (France).

**MASS FLOW RATE MEASUREMENT BY MEANS OF A SONIC THROAT**

Barnard Masure, Jean-Louis Solignac, and Pierre Laval 1971 20 p refs Presented at Symp. on Mass Flows, Pittsburgh, 10 – 14 May 1971

(ONERA-TP-956) Avail: NTIS

The classical influences of the boundary layer and of real gas (virial) effect are discussed. Emphasis is put on the calculation of the Mach number distribution at the throat, as a function not only of throat curvature but also of the wall angle of the convergent. Results are compared with tests on sixteen nozzles made at the ONERA Modane Centre. A practical accuracy of 0.2% was obtained. Author

N71-33030# Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Porz (West Germany). Inst. fuer Angewandte Gasdynamik.

**THE FLOW OF A RAREFIED, DISSOCIATED GAS OVER A SHARP FLAT PLATE [DIE STROEMUNG EINES HOCHVERDUENNTEN, DISSOZIIERTEN GASES UEBER EINE EBENE, VORN SCHARFE PLATTE]**

Ernst-Heinrich Hirschel (Ph.D. Thesis – Tech. Hochschule Aachen) Dec. 1970 97 p refs In GERMAN; ENGLISH summary

(DLR-FB-70-60) Avail: NTIS; ZLDI Munich: 22.40 DM

A method for analyzing nonequilbrium hypersonic flows of low density, two-component gas mixture over a semi-infinite flat plate is developed. The governing equations are derived from nhe Navier-Stokes equations, the energy equation and the species-conservation equations by an order of magnitude analysis. There results a system of partial nonlinear parabolic differential equations for the flow variables in the merged layer regime. The differential equations are integrated by means of an explicit finite-difference scheme. The results so obtained are compared with experimental data and those of other theories. In particular,

vibrational and dissociative (N-N2-system) nonequilibrium in the free stream is being considered and its influence on the flow field is investigated for catalytic and noncatalytic wall conditions. Author (ESRO)

**N71-33169*#** General Electric Co., Cincinnati, Ohio. Aircraft Engine Group.

**EVALUATION OF RANGE DISTORTION TOLERANCE FOR HIGH MACH NUMBER TRANSONIC FAN STAGES, VOLUME 2 Final Report**

C. C. Koch, K. R. Bilwakesh, and V. L. Doyle Aug. 1971 125 p

(Contract NAS3-11157)

(NASA-CR-72964; GE-R71-AEG-133-Vol-2) Avail: NTIS CSCL 20D

Tabulations are presented of the computer output of the data reduction programs. Overall performance data are listed for all undistorted and distorted inlet flow tests; blade element data are listed for both undistorted and radial distortion tests; and, vector diagram data are listed for tests with circumferential inlet flow distortion. Author

**N71-33201*#** General Electric Co., Cincinnati, Ohio. Aircraft Engine Group.

**EVALUATION OF RANGE AND DISTORTION TOLERANCE FOR HIGH MACH NUMBER TRANSONIC FAN STAGES, VOLUME 1 Final Report**

C. C. Koch, K. R. Bilwakesh, and V. L. Doyle Aug. 1971 205 p refs

(Contract NAS3-11157)

(NASA-CR-72806; GE-R71-AEG-133-Vol-1) Avail: NTIS CSCL 20D

The performance and the results of testing a single-stage 1400 ft/sec tip speed transonic compressor are discussed. Tests were conducted with undistorted inlet flow and with both radial and circumferential inlet flow distortions. With undistorted inlet flow, the stage demonstrated a peak adiabatic efficiency at 100% design speed of 0.852 at a total-pressure ratio of 1.624 and an inlet corrected weight flow of 217.2 lb/sec. Stall margin of over 20% was obtained at the above operating condition. Radial and circumferential inlet flow distortions caused substantial reductions in unstalled weight flow range and efficiency. A description of test apparatus and procedure, presentation and analysis of the experimental results, and graphical presentations of the data are presented. Author

**N71-33302*#** Alabama Univ., Huntsville. Div. of Graduate Programs and Research.

**INVESTIGATION OF SCALING CHARACTERISTICS FOR DEFINING DESIGN ENVIRONMENTS DUE TO TRANSIENT GROUND WINDS AND NEAR FIELD, NONLINEAR ACOUSTIC FIELDS Interim Technical Report, Apr. 1970 - May 1971**

Cornelius C. Shih May 1971 69 p refs

(Contract NAS8-30159)

(NASA-CR-119914) Avail: NTIS CSCL 20D

The experimental investigation is presented of propagation phenomena of nonlinear pressure waves in an open-end pipe containing air at atmospheric conditions. An instrumentation system consisting primarily of a battery of hot-film anemometers was used for the measurements of temporal and spacial velocity profiles for various diaphragm burst pressures. In order to gain a better insight of the physical phenomena, a mathematical model was developed by assuming the flow process isentropic. Calculated results from the mathematical model were compared with the experimental data. The discrepancy between the theory and experiment demonstrates the degree of anisotropic nature of the flow process. Results of the investigation of unsteady flow phenomena about a submerged right circular cylinder in various unsteady flow conditions are reported. A set of dimensionless parameters consisting of quantities are presented in terms of local pressure coefficients, lift and drag coefficients versus instantaneous Reynolds number and nondimensional fluid displacement respectively. The measured drag coefficients were found to be comparable with the calculated ones from the pressure coefficients. Author

**N71-33311*#** National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.

**EXPERIMENTAL INVESTIGATION OF THE INFLUENCE OF THE TURBULENT BOUNDARY LAYER ON THE PRESSURE DISTRIBUTION OVER A RIGID TWO DIMENSIONAL WAVY WALL**

Lado Muhlstein, Jr. and Richard G. Beranek Washington Aug. 1971 102 p refs

(NASA-TN-D-6477; A-3846) Avail: NTIS CSCL 20D

The static-pressure distribution was measured on the surface of a series of five rigid sinusoidal wavy wall models at Mach numbers from M = 0.80 to 1.35 and ratios of boundary-layer displacement thickness to model wavelength of 0.0025 to 0.13. Effects of wavelength and amplitude-to-wavelength ratio were examined. For the conditions of the tests, it is shown that the turbulent boundary layer causes a large attenuation of the pressure distribution at subsonic speeds and both an attenuation and a large phase shift relative to the inviscid case of supersonic speeds. These effects are greatest near M = 1.0 and decrease rapidly with increasing or decreasing Mach numbers. At supersonic Mach numbers, the pressure coefficient multiplied by square root of M square minus 1 correlates closely with the thickness of the subsonic portion of the boundary layer. Results extrapolated to zero boundary-layer thickness are presented and compared with three inviscid theories. Author

**N71-33332#** Imperial Coll. of Science and Technology, London (England). Dept. of Mechanical Engineering.

**THE APPLICATION OF A SEMI-ORTHOGONAL FINITE-INTEGRAL TECHNIQUE TO PREDICT INCLINED-PLANE AND CYLINDRICAL COUETTE FLOWS**

R. F. LeFeuvre Dec. 1970 82 p refs

(EF/TN/A/33) Avail: NTIS

A finite integral method of solving the elliptic differential equations for steady flows in two-dimensional domains is presented. Most finite integral or finite difference methods of solving these equations are derived on the basis that the flow domain is mapped by a complete orthogonal grid. However, for some domains of interest orthogonal grids are not easily calculated either by analytical or numerical means. These initial complications are overcome by this finite integral method, which makes use of a simple semiorthogonal grid to map domains with nonrectangular boundaries. The potential usefulness of this semiorthogonal finite-integral method is demonstrated by the predictions of three Couette flows, which have analytical solutions. Author

**N71-33491#** National Research Council of Canada, Ottawa (Ontario). Div. of Mechanical Engineering.

**TUNNEL FLOW BREAKDOWN FROM INCLINED JETS**

R. A. Tyler and R. G. Williamson Mar. 1971 53 p refs

(NRC-LR-545; NRC-11994) Avail: NTIS

Inclined single and paired jets were operated through the regime of floor vortex formation in the NRC 10-ft x 20-ft V/STOL propulsion tunnel. Observed floor stagnation positions are correlated in terms of a jet force coefficient. Limiting conditions for vortex formation (incipient stagnation) are derived for a wide range of jet inclination to the vertical. The observations are discussed in relation to limited existing information on tunnel flow breakdown with models involving vertical jets, and used to infer the influence

of jet inclination on testing limits. Correlated results for the single jet and tandem jet-pair were generally similar, at the same total nozzle area. Author

N71-33494*# Scientific Translation Service, Santa Barbara, Calif.
**SIMULATION OF THE GROUND EFFECT IN THE HYDRODYNAMIC TUNNEL [SIMULATION DE L'EFFECT DE SOL AU TUNNEL HYDRODYNAMIQUE]**
H. Werle Washington NASA Aug. 1971 18 p refs Transl. into ENGLISH from French report TP-63, 1963
(Contract NASw-2035)
(NASA-TT-F-13799) Avail: NTIS CSCL 20D

The ground effect on the flow around models in water tunnels has been simulated by various devices: fixed plates, endless belts, image-models, etc. It has been analyzed by visualizations. A systematic study was made in two dimensional flow (without and with jet effect) and a few three dimensional examples were also studied (low aspect-ratio wings, simulated engine intakes and exhausts). Author

N71-33495+ Imperial Coll. of Science and Technology, London (England). Dept. of Mechanical Engineering.
**STEADY TURBULENT FLOW AND HEAT TRANSFER DOWNSTREAM OF A SUDDEN ENLARGEMENT IN A PIPE OF CIRCULAR CROSS-SECTION**
A. K. Runchal (Kanpur, India) 14 Jun. 1971 26 p refs
(EF-TN-A-39) Avail: NTIS

Streamline and temperature contours, and the corresponding fluxes at the walls, are computed of the elliptic transport equations of vorticity, enthalpy, and turbulence energy, together with auxiliary relations comprising a turbulence model similar to that of Prandtl. The length-scale distribution is determined empirically in order to ensure that the recirculation region has the right length, and the maximum of the wall heat flux occurs at the right place, other empirical inputs are determined from different experiments. Agreement between predictions and experimental data is good. In particular, the correct exponent is predicted for the Stanton number similar to the Reynolds number law. This exponent is uninfluenced by the length-scale distribution. It is suggested that the Prandtl turbulence model be replaced by one embodying two differential equations for turbulence quantities. Author

N71-33514*# City Coll. of the City of New York.
**EXPERIMENTAL DETERMINATION OF PRESSURE DROP AND FLOW CHARACTERISTICS OF DILUTE GAS-SOLID SUSPENSIONS**
Robert Pfeffer and Salvatore J. Rossetti Washington NASA Aug. 1971 49 p refs
(Grant NGL-33-013-029)
(NASA-CR-1894) Avail: NTIS CSCL 20D

The effect of solids loading ratio, particle size, and gas Reynolds numbers on the pressure drop and flow characteristics of a dilute gas-solid suspension in turbulent pipe flow was studied experimentally. Glass beads of 10 to 60 micron diameter were used with air Reynolds numbers of 10,000 to 25,000 and solids loading ratios of up to 2.5. Drag reduction was found to occur for certain particle sizes in both vertical and horizontal flow. An explanation based on the interaction of the particles with the turbulent structure of the fluid near the wall was suggested. Author

N71-33530# Office National d'Etudes et de Recherches Aerospatiales, Paris (France).
**THEORETICAL STUDY OF THE SPACE TIME STRUCTURE OF ACOUSTIC WAVES IN A DUCT**
Patrick Harel and Mariano Perulli 1971 12 p refs Presented at 23d EUROMECH Colloq., Zurich, 5–7 Apr. 1971
(ONERA-TP-965) Avail: NTIS

The concept of energy transport velocity defined under conditions of weak absorption at the walls, has permitted the classification of all possible acoustic modes which can propagate in a duct in the presence of uniform, inviscid, homogeneous, time independent air flow. It was shown that, in a duct whose walls are weakly absorbing: axial flow introduces a frequency dependent distortion of the dispersion curve; and the group velocity is identical with the energy transport velocity, to the lowest order. Author

N71-33558# Idaho Nuclear Corp., Idaho Falls.
**FLOW SIMULATION THROUGH GRAPHICS: A HIGH-SPEED INTERPRETATION OF REACTOR BLOWDOWN CALCULATIONS**
M. A. Lintner and C. W. Solbrig [1970] 28 p refs Presented at the Meeting on New Develop. in Reactor Math. and Appl., Idaho Falls, Idaho, 29 Mar. 1971 Sponsored by AEC
(CONF-710302-4) Avail: NTIS

The various techniques of graphic representation which should be considered when attempting to produce motion pictures portraying fluid motion are discussed. Also, a detailed description of a method used to produce motion picture flow representation in a reactor primary loop is presented. Author (NSA)

N71-33570 Maryland Univ., College Park.
**A STUDY OF MOMENTUM LOSSES AND HEAT TRANSFER EFFECTS IN A SUBSONIC DEFLECTED JET**
Frederick Joseph Page (Ph.D. Thesis) 1969 195 p
Avail: Univ. Microfilms Order No. 70-16027

When a jet is deflected by a plate, a flowfield is formed that is parallel to the plate. A theoretical and experimental investigation is made for a two dimensional, steady state, combustible, turbulent jet flow parallel to a plate. The analytic solution predicts velocity, temperature, and mass fraction profiles. An experimental study was conducted to determine the properties of the combustible propane jet flow along the plate. Velocity and temperature profiles were measured along the plate. In addition, velocity profiles were also measured in a deflected cold air jet. This was done to estimate the effects of heat release upon the flow properties. A comparison of the analytic and experimental results indicates that the analytic model can be used to predict velocity and temperature profiles of the flowfield. Dissert. Abstr.

N71-33581# Imperial Coll. of Science and Technology, London (England). Dept. of Mechanical Engineering.
**TWO NUMERICAL METHODS FOR THREE DIMENSIONAL BOUNDARY LAYERS**
L. S. Caretto, R. M. Curr, and D. B. Spalding Jul. 1971 37 p refs
(EF/TN/A/40) Avail: NTIS

Two finite-difference procedures are described for the computation of steady, three-dimensional boundary layers in ducts. In addition to the velocity components, one method uses pressure as the fourth dependent variable, while the other uses vorticity. Both methods take full account of shear stresses and heat fluxes on planes aligned with the main flow direction, and allow for non-uniform transport and thermodynamic properties. There is no restriction as to boundary conditions. Author

N71-33584# Aeronautical Research Labs., Melbourne (Australia).
**INSTABILITY AND TURBULENCE IN SUPERSONIC AIR INTAKES: THE EFFECTS OF FREE STREAM TURBULENCE, REYNOLDS NUMBER AND SURFACE ROUGHNESS ON SOME AXISYMMETRIC INTAKES AT M EQUALS 1.8 AND 2.2**
D. G. Stewart and S. A. Fisher Nov. 1970 41 p refs
(ARL/ME-129) Avail: NTIS

Instability behaviour has been investigated for a family of external compression axisymmetric intakes of 25 deg cone semi-angle at Mach numbers about 1.8 and 2.2 with variation of Reynolds number, free stream turbulence in the approach stream and surface roughness on the cone. It has been found that, for turbulent boundary layers on the compression surface, instability associated with interaction of this boundary layer with the normal shock may take two forms: the familiar buzz and a much milder phenomenon, flutter, which appears to have all the characteristics of the turbulence known to provoke compressor surge. The incidence of buzz and flutter has been defined as a function of model geometry and operating conditions. Simple relationships are obtained, with the buzz boundary being substantially independent of all factors except lip position angle. Flutter boundaries are additionally dependent on throat length and flutter is found to give rise to buzz in the presence of high free stream turbulence or surface roughness.
Author

**N71-33591*#** Tokyo Univ. (Japan).
**THEORIES OF EQUILIBRIUM FIGURES OF A ROTATING HOMOGENEOUS FLUID MASS**
Yusuke Hagihara Washington NASA 1970 174 p refs
(NASA-SP-186) Avail: SOD $1.75 CSCL 20D

The theory of equilibrium figures of rotating, homogeneous, incompressible fluid mass should be considered a preliminary approach to understanding such natural phenomena in cosmology as the supposition that a star might be divided into a system of double stars or have a ring or nebular arms around it by an increase in its angular speed of rotation with constant angular momentum. Briefly reviewed are: (1) general properties of equilibrium figures; (2) ellipsoidal figures of equilibrium; (3) Lame functions; (4) Poincare theory; (5) Jeans theory; (6) Liapunov theory; (7) Lichtenstein theory; and (8) Poincare tidal theory.
Author

**N71-33611*#** Scientific Translation Service, Santa Barbara, Calif.
**ANALYSIS OF THE RELATIONS BETWEEN ACOUSTIC AND AERODYNAMIC PARAMETERS FOR A SERIES OF DIMENSIONALLY SIMILAR CENTRIGUGAL FAN ROTORS [BEITRAG ZUR ANALYSE DER BEZIEHUNGEN ZWISCHEN DEN AKUSTISCHEN UND STROEMUNGSTECHNISCHEN PARAMETERN AM BEISPIEL GEOMETRISCH AEHNLICHER RADIALVENTILATOR LAUFRAEDER]**
J. Weidemann Washington NASA Aug. 1971 107 p refs
Transl. into ENGLISH from the German report DLR-FB-71-12
(Contract NASw-2035)
(NASA-TT-F-13798; DLR-FB-71-12) Avail: NTIS CSCL 20D

Through the example of free running centrifugal rotors blowing against a sharp edge, it was shown that the fan laws of blade passage and broad band noise can be described by product notations. In particular, it was shown that the frequency dependence of the sound pressure established in the free field is essentially determined by velocity fluctuations on the edge and, independently thereof, by the dimension to the wavelength ratio. Finally, the measurements provided information on the accuracy with which the noise can be calculated for homologous fan series up to a size ratio of 1:10.
Author

**N71-33637*#** Cornell Univ., Ithaca, N.Y.
**SELF-CONFINED ROTATING FLOWS FOR CONTAINMENT**
F. K. Moore and S. Leibovich *In* Florida Univ. Res. on Uranium Plasmas and Their Technol. Appl. 1971 p 95-103 refs (See N71-33626 20-22)
(Grant NGR-33-010-042)
Avail: SOD $3.75; NTIS CSCL 20D

Examples of fluid flows with regions of closed streamlines away from solid boundaries are described with gaseous nuclear fuel containment in mind. Confining mechanisms are rotation (either swirl or smoke ring) or electromagnetic pinch. Experimental experience and a recent theory of vortex breakdown confirm the existence of such flows. Further, it is shown that with suitable choices of parameters, theory predicts constant pressure (stagnation) in the confined regions, which is probably favorable in both stability and mixing-loss terms. Effects of density difference and energy evolution and transfer are discussed.
Author

**N71-33638*#** National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
**STABILITY OF TWO FLUID WHEEL FLOWS WITH AN IMPOSED UNIFORM AXIAL MAGNETIC FIELD**
Carl F. Monnin and John J. Reinmann *In* Florida Univ. Res. on Uranium Plasmas and Their Technol. Appl. 1971 p 105-127 refs (See N71-33626 20-22)
Avail: SOD $3.75; NTIS CSCL 20D

The stability of an incompressible tow-fluid wheel flow to infinitesimal helical disturbances is studied. The inner fluid is heavy and has infinite electrical conductivity, whereas the outer fluid is light and is nonconducting. An axial magnetic field is externally imposed on both fluids. This configuration may be viewed as a Rayleigh-Taylor problem in the frame of the rotating fluid and is dynamically unstable. Growth rates increase with increasing axial wavelength and azimuthal mode numbers but decrease with increasing axial magnetic field. By increasing the magnetic field sufficiently, the system can be made stable to short axial wavelength disturbances for any azimuthal mode.
Author

**N71-33670*#** National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
**A COMPUTER PROGRAM FOR CALCULATING INVISCID, ADIABATIC FLOW ABOUT BLUNT BODIES TRAVELING AT SUPERSONIC AND HYPERSONIC SPEEDS AT ANGLE OF ATTACK**
Richard W. Barnwell and Ruby M. Davis Washington Sep. 1971 72 p refs
(NASA-TM-X-2334; L-7771) Avail: NTIS CSCL 20D

A user's manual is presented for a computer program which calculates inviscid plane, axisymmetric, and three-dimensional flow about blunt bodies traveling at supersonic and hypersonic speeds in a uniform free stream. An exact time-dependent finite-difference method of second-order accuracy is used. The bodies which can be treated include plane and axisymmetric bodies with sharp shoulders and smooth nonaxisymmetric bodies. Equilibrium-air and perfect-gas thermodynamic models can be used. A procedure for approximating equilibrium gases with the perfect-gas model is described. Results include shock-wave location and flow properties at a number of grid points on the body surface, on the shock wave, and in the region between the body and shock as well as descriptions of the input and output, a Fortran 4 program listing, and an input and output for a sample case.
Author

**N71-33681** Rutgers Univ., New Brunswick, N.J.
**DYNAMICAL DESCRIPTIONS OF DIFFUSION IN HYDRODYNAMIC TURBULENCE**
Eugene L. Krasnoff (Ph.D. Thesis) 1970 187 p
Avail: Univ. Microfilms Order No. 70-16936

The Langevin equation is used in a Lagrangian dynamical formulation of diffusion in hydrodynamic turbulence. When the turbulence field is statistically stationary, this formulation gives rise to conditions of stationarity which, in a statistical sense, properly account for the non-linear coupling between the pressure and viscous forces. This coupling effect appears in the necessary dependence of the force correlation on the dynamical friction coefficient. An appropriate modeling of the force correlation is used to calculate the stationary velocity correlation and the fluid particle dispersion. This reproduces G. I. Taylor's theory of diffusion by continuous movements. Now, however, the mean square Lagrangian velocity and the integral time scale of the velocity are specified

in terms of the Langevin model parameters, and a force time scale. These Lagrangian parameters are determined for the case of isotropic turbulence by making use of the Heisenberg spectrum and a mixed Lagrangian-Eulerian form of the Navier-Stokes equations.
Dissert. Abstr.

**N71-33700*#** Translation Consultants, Ltd., Arlington, Va.
**GAS ADSORPTION IN AN ELECTRICAL FIELD [GASADSORPTION IM ELEKTRISCHEN FELD]**
O. Blueh Washington NASA Aug. 1971 17 p refs Transl. into ENGLISH from Z. Physik (West Germany), v. 107, 1937 p 369–381
(Contract NASw-2038)
(NASA-TT-F-13936) Avail: NTIS CSCL 20D

In order to investigate the problem of the effect of an electrical field on gas adsorption, a flow method was worked out in which the change in the concentration in a gaseous mixture could be determined using a method of thermal conductivity. Increased adsorption of carbon dioxide and sulfur dioxide was observed on aluminum plates with an electrical field of 17,000 V/cm between them. The reasons for this effect were discussed. Author

**N71-33713** Illniois Inst. of Tech., Chicago.
**AN EXTENDED COLLISION MODEL IN THE KINETIC THEORY OF GASES**
Ronald Joseph Detry (Ph.D. Thesis) 1970 148 p
Avail: Univ. Microfilms Order No. 70-15428

A contraction of description on a two particle microscopic distribution function and the resulting solution and implications of such a description is discussed. A collision model is proposed for gas molecules which is assumed to behave like elastic spheres. Such a model is postulated by forming molecular chaos, which amounts to an ad hoc closing of the BBGKY hierarchy. A conservation equation is derived for this model and from this twenty five moment equations are obtained. These equations are studied for a ten parameter case and certain necessary relations between various moments and derivatives of moments are obtained. A Chapman-Enskog procedure is developed for the model.
Dissert. Abstr.

**N71-33780** Rutgers Univ., New Brunswick, N.J.
**EXPERIMENTAL INVESTIGATION OF LAMINAR SKIN FRICTION UNDER OSCILLATING FLOW**
John Barth Caldwell (Ph.D. Thesis) 1970 88 p
Avail: Univ. Microfilms Order No. 70-16926

Laminar skin friction response in the presence of a sinusoidal freestream velocity was experimentally investigated. The case of large velocity amplitude variation (50% about 30 ft./sec. mean) at low frequency (1 Hz) was considered. In order to minimize the inherent static pressure variations in an oscillating flow, a modified free jet tunnel (referred to as the open-top tunnel) was constructed. The flow was monitored by two constant-temperature hotwires, one in the freestream and one in the boundary layer. With the open-top tunnel design and under oscillating flow conditions, it was found that the skin friction lagged the freestream velocity. This is in contradiction to all known theories and known experiments. Enclosure of the top, which also increases the static pressure variation, resulted with the skin friction leading the freestream. This anomalous result may be attributable to vertical pressure gradients which exist in the open-top tunnel. Dissert. Abstr.

**N71-33783** Arizona State Univ., Tempe.
**ON POSSIBLE SIMILARITY SOLUTIONS FOR THE LAMINAR FLOW OF A VISCOUS, INCOMPRESSIBLE FLUID BETWEEN ROTATING COAXIAL SURFACES OF REVOLUTION**
Kenneth Wayne McAlister (Ph.D. Thesis) 1970 168 p
Avail: Univ. Microfilms Order No. 70-17422

A particular class of flow fields was investigated and a search was made for possible similarity solutions using the free parameter technique. The governing equations which describe the viscous flow of an incompressible fluid through an arbitrary passage formed by closely spaced coaxial bodies of revolution were considered. The physical boundaries were allowed to rotate at arbitrary angular velocities. Both the flow centerline radius and the local surface spacing were taken as variable. The mathematical model describes the fluid motion in terms of an orthogonal curvilinear coordinate system when specialized for particular metric coefficients. The accuracy of these coefficients depends on the narrow confines of the flow passage and become exact as the surface spacing diminishes in the limit. The simplifications introduced are consistent with the viscous turbine and pump concept.
Dissert. Abstr.

**N71-33811** Rutgers Univ., New Brunswick, N.J.
**THE NEAR WAKE OF A BLUNT BASED AXISYMMETRIC BODY AT MACH .14**
Donald Paul McErlean (Ph.D. Thesis) 1970 149 p
Avail: Univ. Microfilms Order No. 70-16944

A special open circuit steady flow wind tunnel with a closed jet test section and a model support system contained entirely within the tunnel settling chamber were utilized. Detailed pressure measurements were made in all regions of the wake as well as in he approaching flow and on the body surface. The rear stagnation point was located and complete shear layer and recirculation region velocity profiles were obtained. The flow field was found to be quite insensitive to changes in free stream velocity with respect to the base pressure coefficient and the location of the rear stagnation point. The influence of the separation corner extended approximately two base diameters upstream on the body. The dividing streamline was nearly elliptical in shape. There is reasonable agreement for the base pressure but substantial scatter for the length of the recirculation region. Dissert. Abstr.

**N71-33818#** Loughborough Univ. of Technology (England). Dept. of Transport Technology.
**CALCULATIONS OF THE COMPRESSIBLE TURBULENT BOUNDARY LAYER WITH PRESSURE GRADIENT AND HEAT TRANSFER IN INTERNAL FLOWS WITH PARTICULAR REFERENCE TO SUPERSONIC NOZZLES**
E. R. Bergstrom and S. Raghunathan Jun. 1971 20 p refs
(TT-7104) Avail: NTIS

The methods of calculation were based on the differential equations for shape factor and momentum thickness. For one method an assumption was made for the Mach number distribution, for a second method for the distribution of the boundary layer displacement thickness. In a third method an additional differential equation for the Mach number gradient was formulated which dispenses with the need for either of the previous assumptions. When applied to a supersonic nozzle the experimental values of Mach number and displacement thickness were in close agreement with the values calculated by the three methods. The versatility of the third method in predicting the nozzle boundary layer characteristics and exit Mach number for variations in wall temperature and total pressure was demonstrated. Author

**N71-33861** Michigan State Univ., East Lansing.
**THE STABILITY OF BOUNDARY LAYER FLOW SUBJECT TO ROTATION**
Mangal Dass Chawla (Ph.D. Thesis) 1969 135 p
Avail: Univ. Microfilms Order No. 70-15009

The stability of three dimensional Tollmien-Schlichting waves moving in a boundary layer flow on a flat plate which is rotating

about its leading edge is investigated. Primary interest is in the effect of rotation on the critical point of the neutral stability curve. The problem is formulated in terms of a sixth-order differential equation, analogous to the Orr-Sommerfeld equation, with homogeneous boundary conditions. The eigen-value problem thus formed is then transformed into an initial value problem which is solved numerically. The numerical technique developed first solves for the primary velocity profile and its derivatives. Then using a Runge-Kutta fourth order method and a special filtering technique the eigen-values are determined by iteration. The results indicate that as the flat plate rotates into the flow it is destabilizing and as the plate rotates away from the flow it is stabilizing. There is also a span-wise wave number influence which amplifies this effect. The results compare favourably with known experimental results. Dissert. Abstr.

**N71-33863** Maryland Univ., College Park.
**GENERALIZED HYDRODYNAMICS AND ANALYSIS OF CURRENT CORRELATIONS FUNCTIONS**
Narinder Kumar Ailawadi (Ph.D. Thesis) 1969 124 p
Avail: Univ. Microfilms Order No. 70-15477

A generalization of Navier-Stokes equation valid for wavelengths and times of a molecular order of magnitude is proposed on the basis of viscoelastic behavior of simple classical liquids. It is shown that the current-current correlations, which describe the dynamic behavior of liquids, obey a Langevin equation with a memory kernel. The theory is verified by analyzing the data on current correlation functions obtained by Rahman from his computer experiment; this is done by using a one parameter fit to the time dependence of the memory kernel. Three different models for the time dependence of the memory function are used in this analysis, namely, a simple exponential function, a modified exponential function, and a Gaussian. The time dependence of the memory function is also computed numerically from the equation of motion for the correlation function. Dissert. Abstr.

# 13 GEOPHYSICS

**Includes aeronomy; upper and lower atmosphere studies; oceanography; cartography; and geodesy. For related information see also: 20 Meteorology; 29 Space Radiation; and 30 Space Sciences.**

**N71-32816#** California Univ., Berkeley. Hydraulic Engineering Lab.
**FREQUENCIES OF CREST HEIGHTS FOR RANDOM COMBINATIONS OF ASTRONOMICAL TIDES AND TSUNAMIS RECORDED AT CRESCENT CITY, CALIFORNIA**
Charles Petrauskas and L. E. Borgman (Wyo. Univ., Laramie) Mar. 1971 69 p refs
(Contract DACW72-67-C-0002)
(AD-724119; HEL-16-8) Avail: NTIS CSCL 8/3

Of particular concern to the U.S. Army Corps of Engineers is the protection of Crescent City, California from future tsunami damage. Six tsunamis having maximum wave heights greater than one foot have hit Crescent City since 1946 (4) (see Fig. 1). The last two occurred on May 23, 1960 and March 28, 1964. Their wave heights were 10.5 ft and 22-26 ft, respectively, and the tsunamis caused millions of dollars of damage. Presently studies are being conducted by the Corps to evaluate the required height of a seawall fronting the ocean. The report presents a method for taking into account the random occurrence of tsunamis with respect to the astronomical tide. The important parameter describing the tsunamis damage potential is assumed to be the maximum total water level during the occurrence of a tsunami. The total water level is assumed to be the sum of the tide water level and the tsunami water level with respect to the tide. The method is applied to the 1960 and 1964 tsunamis that were recorded on the Crescent City tide gage at Duttons Dock. The result is a histogram of the maximum total water level for each of the tsunamis which can then be used to evaluate the severity of the tsunamis. Author (GRA)

**N71-32817#** Ohio State Univ., Columbus. Dept. of Geodetic Science.
**COMBINATION OF SATELLITE HARMONICS AND GRAVIMETRY**
Helmut Moritz Sep. 1970 32 p refs
(Contract F19628-69-C-0127)
(AD-724123; DGS-146; AFCRL-70-0699; SR-11) Avail: NTIS CSCL 8/5

A relation between the Kaula-Rapp solution and the solution in OSU Report No. 130 is established by deriving the latter solution from a different least-squares principle, whereby this solution is also considerably simplified for practical computation. The covariances, and the solution of Report No. 130 is represented in the form of a correction to the Kaula-Rapp solution. Author (GRA)

**N71-32821#** Academy of Sciences (USSR), Moscow. Inst. for Space Research.
**THEORETICAL MODEL OF THE DIURNAL VARIATIONS OF THE EQUATORIAL EARTH'S THERMOSPHERE STRUCTURE AND DYNAMICS DURING THE EQUINOX**
M. N. Izakov, S. K. Morosov, and E. E. Shnoll 1971 26 p refs Presented at the 14th COSPAR Symp., Seattle, 1971
(D-91) Avail: NTIS

In limits of the spatially two dimensional nonstationary model, the diurnal variations of temperature, density, and winds in the equatorial earth's thermosphere during the equinox at the altitudes of from 120 to 320 km are calculated. A comparison between one and two dimensional models shows the importance of interconnection of thermal regime and dynamics, which may lead to variable shape of density and temperature diurnal variations and in some cases to supersonic motion of the atmospheric gas relative to heat source and to nonlinear effects in the wind distribution. Author (ESRO)

**N71-32870#** European Space Research Inst., Frascati (Italy).
**ON THE STRUCTURE OF THE GEOMAGNETIC TAIL**
Karl Schindler 1971 5 p refs Presented at the Colloq. on Wave-Particle Interaction, Orleans, France, 17–19 Mar. 1971 Submitted for publication
Avail: NTIS

The importance of the plasma sheet for the magnetosphere has been the motivation for a number of investigations which are briefly summarized. It seems reasonable to explore the consequences of a model where the dominant contributoions to the momentum balance of a volume element inside the plasma sheet are the gradient of a scalar pressure balancing the stresses exerted by the magnetic field. Author (ESRO)

**N71-32873#** Institut d'Aeronomie Spatiale de Belgique, Brussels.
**OBSERVATION OF PHENOMENA RESULTING FROM METHANE AND OXYGEN RELEASES AT 160 AND 270 km ALTITUDE. DETERMINATION OF THERMOSPHERIC TEMPERATURES [OBSERVATION DE PHENOMENES RESULTANT DE LACHERS DE METHANE ET D'OXYGENE A 160 ET A A 270 KILOMETRES D-ALTITUDE. DETERMINATION DE TEMPERATURES THERMOSPHERIQUES]**
M. Ackerman, F. Gleizes, and P. Simon 1971 34 p refs In FRENCH; ENGLIS summary Submitted for publication /ts

Aeronomica Acta No. A-86-1971
Avail: NTIS

The results obtained from two rocket flights on July 6 and 13, 1969, in Sardinia (ESRO payloads S64-1 and 2) are given. After the description of the payloads and of the ground based instrumentation, the processes related with the explosion in the thermosphere are described and discussed. The formation of aluminum oxide clouds provides thermospheric temperature determinations. These temperatures are compared with other published data and with thermospheric models computed by Nicolet. The results about winds and densities are also given.
Author (ESRO)

N71-32891# Environmental Protection Agency, Research Triangle Park, N.C.
**AIR POLLUTION ASPECTS OF EMISSION SOURCES: ELECTRIC POWER PRODUCTION. A BIBLIOGRAPHY WITH ABSTRACTS**
May 1971 317 p refs
Avail: SOD $2.25

An annotated bibliography is presented concerning air pollution aspects of emission sources from electric power production. The aspects covered include emission source; control and measurement; atmospheric interaction; effects on human health, plants and livestock, materials, and economics; standards and criteria; legal and administrative; social; and general.
J.M.

N71-32893# Environmental Protection Agency, Research Triangle Park, N.C. Air Pollution Control Office.
**ENVIRONMENTAL LEAD AND PUBLIC HEALTH**
R. E. Engel, D. I. Hammer, R. J. M. Horton, N. M. Lane, and L. A. Plumlee Mar. 1971 39 p refs
(AP-90) Avail: SOD

A summary is given of the major public health problems associated with lead. The discussion includes the scope and nature of the problem; the present scientific and technological knowledge revelant to its solution; the significant gaps in this state of knowledge; the predictions on the growth of the problem; and, in some cases alternative approaches to its solution. Selections are included on lead metabolism and toxicology, diets, consumer goods, and ambient air exposures for the general population.
E.H.W.

N71-32894# Environmental Protection Agency, Research Triangle Park, N.C. Office of Air Programs.
**GUIDELINES: AIR QUALITY SURVEILLANCE NETWORKS**
May 1971 19 p
(AP-98) Avail: SOD

The guidelines to assist State and local agencies in setting up air quality surveillance programs for such pollutants as carbon monoxide, nitrigen dioxide, nonmethane hydrocarbons, and oxidants, are discussed. The development of the system includes determining the number and location of sampling sites, selection of appropriate instrumentation, and establishing a data information system.
E.H.W.

N71-32896*# California Univ., Berkeley. Space Sciences Lab.
**AN INTEGRATED STUDY OF EARTH RESOURCES IN THE STATE OF CALIFORNIA USING REMOTE SENSING TECHNIQUES Annual Progress Report**
Robert N. Colwell, C. West Churchman, Robert Burgy (Calif. Univ., Davis), Gene Thorley, Gerald Schubert (Calif. Univ., Los Angeles) et al 1 May 1971 262 p refs
(Grant NGL-05-003-404)
(NASA-CR-121370) Avail: NTIS CSCL 08D

Recent developments in making remote sensing inventories and socio-economic studies related to earth resources are discussed, emphasizing the California Water Project. Some of the complex socio-economic factors involved in the water project are identified as potential users of future water resources with consideration of their attitudes, prejudices, and needs for information; and potential managers of water resources with consideration of their informational requirements in terms of format, frequency, rapidity, and accuracy. The parameters are defined that govern the yield of water, the surface and subsurface flow of water, and the consumption of the water by plants and animals. Problem areas in measuring hydrologic resource parameters through remote sensing in the Feather River headwaters are described in detail. Examples of the dynamics of earth resource management in California and elsewhere are provided. These include monitoring compliance to laws governing sewage disposal and industrial waste discharge, pollution and eutrophication in lakes and streams, and industrial development and the resultant change in land use and environment.
N.E.N.

N71-32899# Belgian Royal Observatory, Uccle.
**ASTRO-GEO PROJECT SPITSBERGEN Technical Report, 1968–1970**
P. Melchior, M. Bonatz (Bonn Univ., West Germany), and J. Blankenburgh (Norges Geografiske Oppmaling, Oslo) 1970 15 p refs in FRENCH; ENGLISH summary *In its* Commun. Ser. B, No. 52; Geophys. Ser., No. 98
Avail: NTIS

The aims endeavoured to obtain by this mission are: the study of the characteristics of the Earth Tides in the neighbourhood of the North pole, the slow movements of the Earth's crust and an attempt to make a junction of this region to Europe by satellite triangulation.
Author

N71-32908# Royal Inst. of Tech., Stockholm (Sweden). Dept. of Plasma Physics.
**ELECTRODYNAMICS OF THE IONOSPHERE**
Rolf Bostroem Apr. 1971 36 p refs
(Repts-70-21) Avail: NTIS

The effects of electric fields in the ionosphere such as ionospheric current and ionospheric drift are investigated. An electric field will set the charged particles into motion, so the ionization will drift and an electric current will flow. The relations between field, drift velocities, and current are explained.
ESRO

N71-32909# Kiruna Geophysical Observatory (Sweden).
**KIRUNA GEOPHYSICAL DATA: DATA SUMMARY 70/4-8, APRIL–JUNE 1970**
L. Liszka, ed. Jun. 1970 152 p Prepared jointly with ESRANGE
Avail: NTIS

Data recorded at Kiruna, Sweden, during April–June 1970, relating to geomagnetic variations and storms, earth currents, auroras, cosmic noise, and ionospheric absorption are presented.
ESRO

N71-32914 Department of Energy, Mines and Resources, Ottawa (Ontario). Earth Physics Branch.
**CANADIAN NATIONAL REPORT ON GEOMAGNETISM AND AERONOMY, VOLUME 41, NO. 11**
C. M. Carmichael and T. R. Hartz 1971 40 p refs
Avail: Issuing Activity

Studies in geomagnetism and aeronomy by Canadian institutions for the period 1967 through 1970 were briefly reviewed. Geomagnetism headings included: magnetic surveys, magnetic observatories, magnetotellurics and electromagnetic induction, paleomagnetism and rock magnetism, and geomagnetic disturbances

and pulsations. Aeronomy headings included: airglow, atmospheric dynamics, aurora, cosmic rays and particle physics, ionosphere, laboratory studies, magnetospheric disturbances, meteors, and sun-earth relations and magnetospheric physics. A bibliography listing reports published under identical headings was given. J.G.M.

**N71-32922#** Academy of Sciences (USSR), Moscow.
**COSMIC DATA. MONTHLY REVIEW NO. 3**
Mar. 1970 67 p In RUSSIAN and ENGLISH
Avail: NTIS

Observations of geophysical phenomena in the upper atmosphere related to its electric and magnetic states are reported for March 1970. Data are tabulated on geomagnetic variations, ionospheric events, cosmic ray activity, and earth current effects, as well as information on solar activity. A.C.R.

**N71-32938#** Adelaide Univ. (Australia). Dept. of Physics.
**OZONE DETERMINATIONS BY LUNAR ROCKET PHOTOMETRY**
J. H. Carver, B. H. Horton, R. S. O'Brien, and Bryan Rofe (Weapons Res. Estab., Salisbury, Australia) Jun. 1971 16 p refs Sponsored partly by Australian Res. Grants Comm. and Australian Dept. of Supply
(ADP-106) Avail: NTIS

Atmospheric ozone number densities have been determined over the altitude range from 30 to 75 km by measuring the absorption of lunar ultraviolet radiation in a number of wavelength bands between 2400 and 2900 A. The measurements were made from rockets fired at night at times close to full moon and show significant variations in ozone densities particularly at the higher altitudes. Comparison with other observations indicates that above 60 km the ozone densities at night are markedly greater than they are during the day. Author (ESRO)

**N71-32945#** Kiruna Geophysical Observatory (Sweden).
**KIRUNA GEOPHYSICAL DATA: DATA SUMMARY 69/10-12, OCTOBER–DECEMBER 1969**
L. Liszka, ed. Dec. 1969 151 p Prepared jointly with ESRANGE
Avail: NTIS

Data recorded at Kiruna, Sweden, during October–December 1969, relating to geomagnetic variations and storms, earth currents, auroras, cosmic noise, and ionospheric absorption are presented. ESRO

**N71-32950#** Defense Documentation Center, Alexandria, Va.
**PHOTOGRAMMETRY Report Bibliography, Apr. 1947–Mar. 1970**
May 1971 141 p refs
(AD-724510; DDC-TAS-71-21-1) Avail: NTIS CSCL 8/2

The bibliography contains annotated references on Photogrammetry. Some of the topics are: geodetic photogrammetric research and technique development, computer programs for the reduction of photogrammetric cloud data, electronic photogrammetry, some thoughts on automation in photography, aerial photography used in mapping vegetation and soils, and some new approaches in photogrammetric techniques. Author (GRA)

**N71-32961#** Naval Oceanographic Office, Washington, D.C.
**PHOTOGRAMMETRY IN MARINE INVESTIGATIONS OF HYDROTECHNICAL PROJECTS. CHAPTER 4: STEREOPHOTOGRAPHY OF ICE**
D. I. Nikoforov 1971 11 p Transl. into ENGLISH from the Monograph "Fotogrammetriya V Morskikh Issledovaniyakh Pod Gidrotekhnicheskie Sooruzheniya" Leningrad, 1957 p 73–78
(AD-724464; NOO-TRANS-113) Avail: NTIS CSCL 8/12

Stereophotography of ice is analyzed so as to present the significance of photographic records in determining the type of ice, its mass and displacement in areas where hydrotechnical structures are to be built. Author (GRA)

**N71-32983#** Kansas Univ., Lawrence. Center for Research.
**GEOMORPHIC EVALUATION OF RADAR IMAGERY OF SOUTHEASTERN PANAMA AND NORTHWESTERN COLOMBIA**
Anthony J. Lewis Feb. 1971 178 p refs
(Contract DAAK02-68-C-0089)
(AD-724118; CRES-TR-133-18; ETL-CR-71-2) Avail: NTIS CSCL 8/2

The purpose of this study is to evaluate the potential of radar imagery for use in geomorphic analysis, using southeastern Panama, including Route 17, and northwestern Colombia as the test site. More specifically, radar-derived morphometric data will be compared to morphometric data from 1:50,000 maps of Route 17 and from the limited aerial photography of eastern Panama. The consistency of radar-derived morphometric data will be tested at different depression angles and look-directions. Author (GRA)

**N71-32984#** Army Cold Regions Research and Engineering Lab., Hanover, N.H.
**COLD REGIONS SCIENCE AND ENGINEERING MONOGRAPH 3, SECTION B1A: WINTER REGIME OF RIVERS AND LAKES**
Bernard Michel Apr. 1971 140 p refs
(AD-724121; CCREL-CRSE-3-B1A) Avail: NTIS CSCL 8/12

The monograph summarizes existing knowledge of river and lake ice surveys, heat balance on open water in winter, frazil, ice cover formation, ice breakup and ice control. Author (GRA)

**N71-32986#** Naval Weapons Lab., Dahlgren, Va.
**ATMOSPHERIC DENSITY VARIATIONS AT 1000 KILOMETERS ALTITUDE**
Richard J. Anderle Apr. 1971 35 p refs
(AD-724638; NWL-TR-2568) Avail: NTIS CSCL 4/1

Scaling factors for atmospheric density were computed from Doppler observations made on polar satellites at an altitude of 1000 km. The scaling factors, which were computed at 48 hours intervals, show that the atmospheric at 1000 km altitude is affected by increases in solar flux and magnetic index as has been previously noted for satellites at lower altitudes. The prediction errors for the satellites are about 25 meters after 24 hours and about 100 meters after 48 hours. Author (GRA)

**N71-32988** Department of Energy, Mines and Resources, Ottawa (Ontario). Earth Physics Branch.
**DETERMINING MEAN HOURLY VALUES BY ELECTRONIC INTEGRATION**
W. R. Darker 1971 7 p refs *Its* Publ. of the Earth Phys. Branch, Vol. 41, No. 7
(M70-41/7) Avail: Issuing Activity

An electronic integrator with a time constant of one hour was constructed for determining, in real time, the mean hourly values of the magnetic field. After calibration, the error in output did not exceed 5 mv for an input voltage of 1 volt. Temperature drift, referred to the output, is 0.2 per cent/degree C. Used with a fluxgate magnetometer giving a signal of 10 mv/gamma the integrator should produce mean hourly values accurate to 1 gamma (0.00001) gauss. Author

**N71-32997#** Deutscher Wetterdienst, Offenbach am Main (West Germany).
**CONTRIBUTIONS TO THE METHODOLOGY OF WATER**

**SURFACE TEMPERATURE MEASUREMENTS USING INFRARED RADIATION THERMOMETERS [ZUR METHODIK DER OBERFLAECHENTEMPERATURMESSUNG VON WASSER MIT INFRAROT-STRAHLUNGSTHERMOMETERN]**
Dieter Lorenz Bonn Bundeswehramt 1971 68 p refs In GERMAN; ENGLISH summary Sponsored by Bundesmin. fuer Verteidigung
(BMVg-FBWT-71-6) Avail: NTIS; Bundeswehramt, Bonn: 25 DM

Results of theoretical and experimental radiometric measurements of water surface temperatures are presented. A description is given of the experimental set-up and the necessary corrections. Comparison of these and bucket thermometer measurements show agreement and confirm the usefulness of this method. ESRO

**N71-33013#** Kiruna Geophysical Observatory (Sweden).
**KIRUNA GEOPHYSICAL DATA: DATA SUMMARY 70/7-9, JULY–SEPTEMBER 1970**
L. Liszka, ed. Sep. 1970 129 p Prepared jointly with ESRANGE
Avail: NTIS

Data obtained at Kiruna, Sweden, during July–September 1970, relating to geomagnetic variations and storms, earth currents, aurorae, cosmic noise, and ionospheric absorption are presented. ESRO

**N71-33018*#** Smithsonian Astrophysical Observatory, Cambridge, Mass.
**APOLLO CONTAMINATION ANALYSIS, PART 1 Final Report**
Jul. 1971 31 p refs
(Grant NGR-09-015-105)
(NASA-CR-121382) Avail: NTIS CSCL 03B

The reduction and analysis of the extensive photographic observations of the solid particle clouds produced by hydrogen, oxygen, or water venting into space during the Apollo 12 mission are reported. The number of Baker–Nunn photographs to be analyzed from Apollo 12 required that film measurement and data processing be automated. Appropriate computer programs were prepared to process the image-density measurements. The specific procedures used in the data reduction are documented. Author

**N71-33020*#** National Aeronautics and Space Administration, Ames Research Center, Moffett Field, Calif.
**LAVA TUBES OF THE CAVE BASALT, MOUNT SAINT HELENS, WASHINGTON**
Ronald Greeley and Jack H. Hyde (Geol. Surv., Tacoma, Wash.) May 1971 60 p refs
(NASA-TM-X-62022) Avail: NTIS CSCL 08G

The Cave Basalt, a high-alumina pahoehoe flow containing numerous lava tubes which originated at the southwest flank of Mount St. Helens, southwestern Washington, and flowed down a stream valley incised in older pyroclastic flow deposits is described. In situ charcoal samples from two localities within lava tubes yield C-14 dates of 1860 + or − 250 years B.P. and 1925 + or − 95 years B.P. A detailed survey of 9125 m of lava tubes, correlated with surface geologic maps, yielded several geomorphic relationships of basalt flows. Most of the lava tubes apparently formed between shear planes in laminar lava flow, although some tube sections show evidence that the tube roof formed by accretion of spattered lava in turbulent flow. Partial collapse of tube interiors revealed: 1) the wall separating the tube interior from the preflow country rock may be thinner than 25 cm, 2) lava flows can erode the surface over which they flow, 3) collapse of the tube interior can occur immediately after the tube has been drained of molten lava and before the walls cool completely, 4) lava tubes may represent the thickest part of the lava flow, occupying topographic lows (stream channels) and 5) tubes can be modified extensively through accretion and erosion by later lava flows. Author

**N71-33026#** Environmental Protection Agency, Research Triangle Park, N.C. Air Pollution Technical Information Center.
**NITRIC ACID MANUFACTURING: A BIBLIOGRAPHY WITH ABSTRACTS**
May 1971 38 p refs *In its* Air Pollution Aspects of Emission Sources, No. 93
(AP-93) Avail: SOD

Nitric acid manufacturing contributes significantly to the overall air pollution level in the United States. To aid efforts to improve air quality, a bibliography relevant to the problem and its solution was compiled. Approximately 81 abstracts were selectively screened from the information storage and retrieval system to cover the 14 categories set forth in the table of contents. The compilation is intended to be representative of available literature, and no claim is made to all-inclusiveness. Author

**N71-33038#** Istituto di Fisica dell'Atmosfera, Rome (Italy).
**AN EXPERIMENTAL CHECK ON THE REMOVAL OF RADON**
G. Dalu and G. A. Dalu Sep. 1970 16 p refs Presented at the Colloq. on Phys. and Chem. of Aerosols, Fontenay-aux-Roses, France, 24–25 Sep. 1970 (IFA-RDP-33) Avail: NTIS

Experiments in the past suggested that a partial removal of radon from the atmosphere occurs by washout. To test this, direct measurements were made of radon concentration in an isolated environment which was enriched with this gas and in which fog was produced artificially. Similar measurements were also made in the presence of a high potential gradient. From these experiments, it has been established that the only process which eliminates radon from the atmosphere is the radioactive decay of the radon itself. Author (ESRO)

**N71-33044#** Institut d'Aeronomie Spatiale de Belgique, Brussels.
**DEUTERIUM DISTRIBUTIONS IN THE EARTH'S UPPER ATMOSPHERE**
G. Kockarts 1971 13 p refs Presented at the COSPAR Symp. on Dyn. of the Thermosphere and Ionosphere above 120 km, Seattle, 24–26 Jun 1971 Submitted for publication *Its* Aeronomica Acta No. A-85-1971
Avail: NTIS

The physical conditions leading to a deuterium enhancement in the earth's upper atmosphere are discussed as a function of the thermopause temperature and of the eddy diffusion coefficient. It appears that changes in the eddy diffusion can induce large variations in the deuterium concentration for temperatures less than 1500 K. Under those conditions, the inefficiency of thermal escape should be compensated by the polar wind process. As the deuterium total content is relatively small compared to that of atomic hydrogen, the best observational conditions occur for thermopause temperature around 1250 K. Author (ESRO)

**N71-33047** Department of Energy, Mines and Resources, Ottawa (Ontario).
**PUBLICATIONS OF THE EARTH PHYSICS BRANCH, VOLUME 41, NUMBER 6: RECORD OF OBSERVATIONS AT VICTORIA MAGNETIC OBSERVATORY, 1969**
D. R. Auld and I. W. Fetterley 1971 56 p refs
(M70-41/6) Avail: NTIS

Tables of horizontal intensity, declination, and vertical intensity at the Victoria Magnetic Observatory are presented. The data include hourly values; hourly, daily, and monthly means; summary by month, season, and year of mean hourly values for all days and for the international quiet and disturbed days; and three-hour range indices. N.E.N.

**N71-33082#** Chicago Univ., Ill. Lab. for Atmospheric Probing
**RADAR MEASUREMENT OF ATMOSPHERIC TURBULENCE Quarterly Progress Report, 1 Dec. 1970–28 Feb. 1971**

Robert Serafin and David Atlas 31 Mar. 1971 35 p refs
(Contract N00014-67-A-0285-0014)
(AD-724322; QPR-1) Avail: NTIS CSCL 4/1

A theoretical error analysis of radar measurements of the turbulence structure function was completed. In addition, the incoherent turbulence detector described by Atlas and Srivastava (1969) was designed and most of the required circuits constructed. A detailed theoretical analysis is given. Author (GRA)

**N71-33083#** Wisconsin Univ., Middleton. Geophysical and Polar Research Center.
**USE OF ACOUSTIC SCATTERING THEORY TO INTERPRET MARINE GEOPHYSICAL DATA**
W. K. Leong, T. K. Kan, and C. S. Clay Apr. 1971 37 p refs *Its* Contrib. 259
(Contract N00014-67-A-0128-0009)
(AD-724321; RR-71-1) Avail: NTIS CSCL 8/10

The character of echo sounding profiles can be used to estimate the presence and magnitude of microtopography or bottom roughness. These are sea floor features whose lateral dimensions are smaller than the illuminated area and cannot be resolved by conventional vertical-beam echo sounding techniques. Vertical roughness may be estimated by studying the character of the returned signal. To test this, a laboratory experiment was conducted. The dependence of the reflected signal on the roughness of the surface was measured. Author (GRA)

**N71-33096#** Air Force Cambridge Research Labs., Bedford, Mass.
**CHARACTERISTICS OF UPPER ATMOSPHERE BARIUM, TRIMETHYLALUMINUM, DIBORANE AND LITHIUM RELEASES, 1969**
William K. Vickery 26 Oct. 1970 41 p *Its* Air Force Surv. in Geophys., No. 226
(AD-724099; AFCRL-70-0691) Avail: NTIS CSCL 4/1

The report summarizes the flight and engineering aspects of rocket launches made by the Chemical Physics Branch (USAF Project 7635) during the calendar year 1969, inclusive of TMA vapor release system development flights since 1966, for the purpose of releasing chemicals in the atmosphere at high altitudes. Chemical releases provide means for modification of the upper atmosphere, as well as data on atmospheric dynamics and ionospheric properties from which quantitative understanding of increasing accuracy is derived. Results of this research are relevant to the solution of current Air Force problems, such as the precise prediction of the motion of operational satellites and nuclear debris, or the assessment of the effects of solar bursts and nuclear detonations on the propagation of electromagnetic waves through the ionosphere. The four basic experimental release systems, barium, trimethylaluminum, diborane, and lithium, are designated as individual sections. In addition, information is included regarding new instrumentation tested in some of the flights, in order to improve the acquisition capability of the tracking radar and to transmit vehicle and payload operational data. Author (GRA)

**N71-33101#** Academy of Sciences (USSR), Moscow.
**COSMIC DATA, MONTHLY REVIEW, NO. 4, APRIL 1970**
Apr. 1970 52 p In RUSSIAN; ENGLISH summary
Avail: NTIS

Results are presented of observations on geophysical phenomena concerning electric and magnetic states of the upper atmosphere (geomagnetic variations, ionosphere, cosmic rays, and earth currents). Data on solar activity are included. Author

**N71-33104*#** National Aeronautics and Space Administration, Washington, D.C.
**EARTH ALBEDO AND EMITTED RADIATION**
Jul. 1971 48 p refs
(NASA-SP-8067) Avail: NTIS CSCL 03B

Data are given for global annual averages of earth albedo and radiation to use in estimating long term effects on space vehicle equipment and surfaces. For shorter term effects, extremes are given which may be encountered because of geographical, seasonal, and diurnal variations. Spectral distributions of albedo and earth radiation is also treated. The recommended values incorporate results of the extensive measurements from spacecraft which were important in revising earlier estimates. A related design criteria monograph on solar electromagnetic radiation gives values for the solar constant and solar spectral irradiance which were developed from high altitude measurements made from aircraft, balloons, and spacecraft. Author

**N71-33151#** Naval Research Lab., Washington, D.C.
**A VHF THOMSON SCATTER RADAR STUDY OF THE MIDLATITUDE IONOSPHERE USING THE FARADAY EFFECT Interim Report**
John M. Goodman 21 Apr. 1971 96 p refs
(AD-724298; NRL-7221) Avail: NTIS CSCL 4/1

In recent years Thomson scatter radars have provided the upper-air physicist with a detailed view of the topside ionosphere. These instruments are generally capable of providing continuous information about the electron concentration between a height of roughly 100 km and the base of the exosphere. This report describes some results obtained with the Randle Cliff Radar, a new midlatitude Thomson scatter facility which utilizes Faraday rotation for the purpose of deducing electron density. An operating frequency of 140 MHz is employed at Randle Cliff, and this frequency is about optimum for making such measurements. In this report an investigation of Faraday dispersion id detailed, and this usually deleterious phenomenon is utilized in an alternative scheme to determine electron density profiles. Other features of the study include: a comparison of Thomson scatter results with total electron content deduced from ATS-5 satellite transmissions, a detection of quasi-periodicites over Randle Cliff and their relationship to internal gravity waves, and discussions of the midday biteout and F region response to solar eclipse. Author (GRA)

**N71-33153#** Vermont Univ., Burlington. Dept. of Civil Engineering.
**PARAMETERIZATION OF OBSERVED HYDROGRAPHS**
Richard N. Downer Dec. 1970 65 p refs Sponsored by the Dept. of The Interior
PB-196899; Rept-1) Avail: NTIS CSCL 08H

A simple transformation of the incomplete gamma function is used to describe single-peaked hydrographs. A weighted least squares method produces a forced fit of the crest portion of the observed hydrograph. In addition to determining the parameters of the fit with minimum squared deviations, the computer plots the original and fitted hydrographs and calculates statistics to assist in making an objective decision as to the hydrological goodness-of-fit. A good least squares fit does not necessarily result in a good hydrologic fit. Judgment of goodness-of-fit on the central portion of the hydrograph is aided by a significance test which combines the number of data points with features of the ocular fit. The complete goodness-of-fit test assumes that: (1) the assumed model is correct; and (2) if the model is a correct one, there is a close mathematical relation between the observed and fitted data. GRA

**N71-33157#** Naval Ship Research and Development Center, Panama City, Fla.
**A SIMULATION OF THE SWELL-INDUCED MAGNETIC VECTOR IN A SHALLOW SEA**
Patrick N. Carlton Jan. 1971 31 p refs
(AD-724656; NSRDL/PC-3447) Avail: NTIS CSCL 8/14

A method for the generation of a realistic representation of an ocean parameter is outlined. The particular parameter chosen is the swell-induced magnetic field vector in a shallow sea. The method can be applied to other parameters such as ambient acoustic pressure, and velocity field noises. Starting from a periodic representation of the swell-induced magnetic field, the simulation of the random time behavior of the parameter is obtained by amplitude modulation of a superposition of these periodic functions. This superposition is designed to produce a function with a frequency range comparable to the swell frequency band. The modulation is applied intermittently at random instants of time. This approximation of the three Cartesian components of the swell-induced magnetic field has been calculated for the purpose of providing a background noise signal for a test of a proposed signal analysis scheme. Author (GRA)

**N71-33170#** Royal Inst. of Tech., Stockholm (Sweden). Dept. of Plasma Physics.

**THE MAGNETIC FIELD OF THREE-DIMENSIONAL MAGNETOSPHERIC MODEL CURRENT SYSTEMS AND CURRENTS INDUCED IN THE GROUND**

Rolf Bostroem 1971 30 p

(APS-PH-77) Avail: NTIS

High-latitude magnetic disturbances are caused by currents flowing in the auroral ionosphere and along the geomagnetic field lines connecting the ionospheric part of the current system with currents in the outer magnetosphere. Methods used to study the magnetic disturbances of model current systems including field-aligned currents as summarized. Direct integration, spherical harmonic expansion, and effects of currents induced in the ground are discussed and some examples given. Author

**N71-33176#** Naval Civil Engineering Lab., Port Hueneme, Calif.

**WAVE ENERGY EXTRACTION BY CRESCENT SHAPED COLUMNS FOR STATION KEEPING OF FLOATING OCEAN PLATFORMS: HYDRAULIC MODEL AND FEASIBILITY STUDY**

C. L. Liu and R. H. Feshbaugh Mar. 1971 68 p refs

(AD-724673; NCEL-TN-1156) Avail: NTIS CSCL 13/10

Fixed or floating column-supported platforms in the ocean experience direct and reverse wave drag caused by the oscillating water particle velocity. The drag coefficient for the direct flow can be different from that for the reverse flow if the cross-sectional area of the supporting column is not symmetric about the column axis. Therefore, a net wave drag force theoretically can be produced. The purpose of this study was to determine whether this concept can be utilized to reduce the power requirements for positioning large floating platforms such as the proposed Mobile Ocean Basing System (MOBS). Author (GRA)

**N71-33181#** Ohio State Univ., Columbus. Dept. of Geodetic Science.

**MOLODENSKY'S SERIES AND ANALYTICAL CONTINUATION**

Helmut Moritz Sep. 1970 42 p refs

(Contract F19628-69-C-0127)

(AD-724133; DGS-145; AFCRL-70-0698; SR-10) Avail: NTIS CSCL 8/5

It is shown that the Molodensky series solution and the solution of OSU Report 126, based on analytical continuation, are asymptotic series satisfying the basic equations in terms of which the problems are formulated. For the investigation of the second solution, analytical continuation to a level surface completely outside the topographic masses is used. The result provides a logical completion of the proof of equivalence of these two series solutions. It is also shown that the results of the method of Report 126 are the same regardless of the level surface, to which analytical continuation is made. This completes the justification of the formal use of analytical continuation into the interior of the topographic masses. Author (GRA)

**N71-33196#** Naval Oceanographic Office, Washington, D.C.

**SEASONAL AND YEARLY VARIATIONS IN THE ICINESS AND THE POSITION OF ICE EDGE IN THE BLACK AND AZOV SEAS, WHICH ARE ASSOCIATED WITH ATMOSPHERIC CIRCULATION [SEZONNYE I MEZHGODOVYE IZMENENIYA LEDOVITOSTI I POLOZHENIYA KROMKI LDA NA CHEROM I AZOVSKOM MORYAKH V SVYAZI S OSOBENNOSTYAMI ATMOSFERNOI]**

A. N. Kryndin 1971 98 p refs Transl. into ENGLISH from Tr. Gos. Okeanogr. Inst. (Moscow), v. 76, 1964 p 1–79

(AD-724671; NOO-TRANS-522) Avail: NTIS CSCL 8/12

Investigations of seasonal and yearly variations in the iciness (ice area plus ice thickness) and the position of ice edge in the Black and Azov Seas are discussed. The study is based on shipboard and aircraft observations of ice. The concluding chapter deals with investigations in the fluctuations of iciness associated with seasonal and yearly variations in atmospheric circulation over the North Atlantic Ocean and the western Eurasia. The findings are expressed in mathematical formulae that can be used in the forecasting of ice conditions and the position of the ice edge. Data on the severeness of winters in the Black and Azov Seas, the thickness and duration of ice cover are tabulated. Author (GRA)

**N71-33197#** Naval Oceanographic Office, Washington, D.C.

**CHANGES IN THE POSITION OF ICE EDGE IN NORTH CASPIAN AND THE PROSPECTS OF THEIR FORECASTING [OB IZMENCHIVOSTI POLOZHENIYA KROMKI LDA V SEVERNOM KASPII VOZMOZHNOSTI EE PREDSKAZANIYA]**

E. S. Karakash 1971 33 p refs Transl. into ENGLISH from Tr. Gos. Okeanogr. Inst. (Moscow), v. 76, 1964 p 80–103

(AD-724672; NOO-TRANS-523) Avail: NTIS CSCL 8/12

Yearly, monthly and ten-day changes in the position of ice edge in the North Caspium are discussed in detail, giving data on the width of shore ice and drift ice belts. The ice edge is related to the intensity of atmospheric circulation, air temperature, iciness and synoptic processes prior to forecasting. Equations used in forecasting the position of ice edge have large correlation coefficients (more than 80). The reliability of forecasting based on equations exceeds the natural reliability and is slightly smaller than the inertial reliability, no matter what the calculation errors are. The data on iciness in the North Caspium are reduced to the 15th day of each month from 1928 to 1962. In addition, coordinates of ice edge are given for the period. Author (GRA)

**N71-33200#** Aeronautical Chart and Information Center, St. Louis, Mo. Technical Library Section.

**A NEW METHOD OF CALCULATING THE VERTICAL DERIVATIVES OF THE EARTHS ACCELERATION [NOVYI METHOD OBCHYSLENNYA VERTYKALNYKH PODHIDNYKH ZEMMNOGO PRYSKORENNYA]**

I. F. Monin Nov. 1970 13 p refs Transl. into ENGLISH from Dopovidi Akad. Nauk Ukr. RSR, Ser. B: Geol. Geofizyka, Khim. ta Biol. (Kiev), no. 12, 1967 p 1085–1090

(AD-724498; ACIC-TC-1673) Avail: NTIS CSCL 8/5

The paper discusses a new method of calculating the vertical derivatives of the earths acceleration. It is necessary to note that the formulae proposed characterize the external gravity field of the real earth. Author (GRA)

**N71-33207#** Pennsylvania State Univ., University Park. Ionosphere Research Lab.

**STUDIES OF E REGION IONOSPHERIC MOVEMENTS**

**FROM MEASUREMENTS OF THE GROUND DIFFRACTION PATTERN PRODUCED BY 300-KHz RADIO WAVE REFLECTIONS**

George R. P. Bulman 19 Jul. 1971 126 p refs
(Grant NSF GA-12228)
(PSU-IRL-SCI-371) Avail: NTIS

An automatic recording system for making amplitude and phase measurements of the ground diffraction pattern produced by the ionospheric reflection of a 300-kHz pulsed radio signal at vertical incidence is described. A linear array of five antennas was connected to a receiver by a single transmission line and measurement of the complex amplitude from each antenna was made every nine seconds. The traditional correlation analysis of Briggs, Phillips and Shinn was compared to the generalized correlation analysis of Booker, Ratcliffe and Shinn. It was shown that the amplitude correlation function and the magnitude of the complex correlation function were the same if the reflecting mechanism produces a large number of random doppler frequency components of approximately equal strength. The complex power spectrum analysis used by Pfister was reviewed. Representative amplitude and phase records and complex correlation functions obtained from six nighttime test runs, each lasting about forty minutes, were included. Author

**N71-33209*#** Geological Survey, Menlo Park, Calif.
**AN EVALUATION OF ENHANCEMENT OF LIGHT INTENSITY DIFFERENCES ON COLOR AERIAL PHOTOGRAPHS AND THERMAL INFRARED IMAGERY FOR THE OZETTE ISLAND: CAPE ALAVA AREA OF THE OLYMPIC COAST OF WESTERN WASHINGTON**

Richard J. Janda Mar. 1971 30 p refs
(NASA Order R-09-020-015; NASA Order N62306-70-C-0200)
(NASA-CR-121430) Avail: NTIS CSCL 08C

In a test of the utility of light intensity separated images in evaluating the natural resources of geologically complex coastal areas, 17 splits were obtained from the original color photograph and 13 splits were obtained from the original thermal infrared image. A comparison was then made between the splits and features mapped from the original photograph and image to see if the separated images or combinations enhanced or hindered perception of these features. Lists of features enhanced and hindered are included. The conclusion is drawn that this enhancement technique does not generate significantly more useful information than can be obtained from the original photograph and image in this area. However, the combined use of color aerial photographs and infrared imagery does generate significant new information. Author

**N71-33230#** Environmental Protection Agency, Research Triangle Park, N.C. Air Pollution Control Office.
**PROCEEDINGS OF SYMPOSIUM ON MULTIPLE SOURCE URBAN DIFFUSION MODELS**

Arthur C. Stern 1970 437 p refs Symp. held at Chapel Hill, N.C., 27-30 Oct. 1969
(PB-198400; AP-86) Avail: SOD $1.75; NTIS HC $6.00/MF $0.95 CSCL 13B

Data are presented covering diffusion models for air pollution abatement and control. The physical and meteorological parameters for urban diffusion processes are also discussed. Diffusion models are given of carbon monoxide, atmospheric movement, tracer clouds, spatial distributions, and sulfur dioxide. Sensitivities of air quality prediction to input errors and uncertainities are presented. E.H.W.

**N71-33235#** Aeronautical Chart and Information Center, St. Louis, Mo. Technical Library Section.
**SOME NEW EQUATIONS FOR DETERMINING THE DEPTH TO THE CENTER OF GRAVITY AND THE SURPLUS MASS OF DISTURBING BODIES FROM GRAVITY ANOMALIES [DEYAKI NOVI SPIVVIDNOSHENNYA DLYA VYZNACHENNYA GLYBYNY DO TSENTRA VAGY TA NADLYSHKOVOI MASY ZBURYUYUCHYKH TIL ZA GRAVITATSIYNYMY ANOMALIYAMY]**

V. O. Dyadyura and V. I. Starostenko Nov. 1970 10 p refs Transl. into ENGLISH from Dopovidi Akad. Nauk Ukr. RSR, Ser. B: Geol. Geofizyka, Khim. ta Biol. (Kiev), no. 9, 1967 p 804-808
(AD-724499; ACIC-TC-1674) Avail: NTIS CSCL 8/5

Recently, in the practice of interpretation of gravity anomalies, simple methods for determining the depth of occurrence and the surplus mass of disturbing bodies have obtained a rather broad expansion. Among them, E. G. Bulakhs methods, which exclude errors in the selection of level for the normal field, are very often used. Some new equations are suggested in this work, which provide a greater accuracy in the determination of the parameters of disturbing bodies, and the connection of these equations with E. G. Bulakhs formulae is presented. Author (GRA)

**N71-33249*#** Carnegie Institution of Washington, D.C. Geophysical Lab.
**GEOPHYSICAL LABORATORY Annual Report of the Director, 1969-1970**

Repr. from Carnegie Inst. Year Book 1969, Jan. 1971 p 229-238 *Its* Papers from the Geophys. Lab. No. 1580
(Contract NAS9-10445)
(NASA-CR-115097) Avail: NTIS CSCL 08G

A comparison of the Apollo 12 samples from Oceanus Procellarium with the Apollo 11 samples from Mare Tranquillitatis reveals certain chemical similarities. Both suites show distinctive features of high concentrations of refractory elements and low contents of volatile elements. These features most clearly distinguish lunar material from terrestrial or meteoritic material. Author

**N71-33287+** Institut Royal Meteorologique de Belgique, Brussels.
**OZONE OBSERVATIONS Quarterly Bulletin No. 2, 1968 [OBSERVATIONS D'OZONE]**

1968 38 p refs In FRENCH and FLEMISH
Avail: NTIS

Spectrophotometric total ozone measurements are reported for the time April through June, 1968. The presented ozonograms contain designations for partial ozone pressure and atmospheric diffusion, air temperature, and used wavelengths. Transl. by G.G.

**N71-33294#** National Physical Lab., New Delhi (India). Radio Propagation Unit.
**SOLAR AND GEOPHYSICAL DATA, PART 2**

Dec. 1970 25 p
(RRC-A186-Pt-2; SG-59) Avail: NTIS

Predicted and observed solar and geophysical data for December 1970 are presented in tables and graphs. The data include sunspot numbers, solar flux, solar flares and their effects, magnetic storms, and SID effects. Author

**N71-33295#** National Physical Lab., New Delhi (India). Radio Propagation Unit.
**SOLAR AND GEOPHYSICAL DATA, PART 2**

Jan. 1971 17 p
(RRC-A187-Pt-2; SG-60) Avail: NTIS

Predicted and observed solar and geophysical data for January 1971 are presented in tables and graphs. The data include sunspot numbers, solar flux, solar flares and their effects, magentic storms, and SID effects. Author

**N71-33296#** National Physical Lab., New Delhi (India). Radio Propagation Unit.

**SOLAR AND GEOPHYSICAL DATA, PART 2**
Feb. 1971 16 p
(RCC-A188-Pt-2; SG-61) Avail: NTIS

Predicted and observed solar and geophysical data for February 1971 are presented in tables and graphs. The data include sunspot numbers, solar flux, solar flares and their effects, magnetic storms, and SID effects. Author

**N71-33297#** National physical Lab., New Delhi (India). Radio Propagation Unit.
**SOLAR AND GEOPHYSICAL DATA, PART 2**
Mar. 1971 12 p
(RRC-A189-Pt-2; SG-62) Avail: NTIS

Predicted and observed solar and geophysical data for March 1971 are presented in tables and graphs. The data include sunspot numbers, solar flux, solar flares and their effects, magentic storms, and SID effects. Author

**N71-33298#** Chicago Univ., Ill. Dept. of the Geophysical Sciences.
**A MOLECULAR THEORY OF THE HOMOGENEOUS NUCLEATION OF ICE FROM SUPERCOOLED WATER**
William J. Eadie (Ph.D. Thesis) Jun. 1971 127 p refs
(Grants NSF GA-3881; NSF GA-20470)
(TN-40) Avail: NTIS

A statistical thermodynamic model of liquid water was developed and used to extract, from thermodynamic data on liquid water, information relevant to the molecular interactions at an ice-water interface. The model was used as the basis for a statistical thermodynamic evaluation of the surface and edge contributions to the free energy of formation of an ice embryo from supercooled water. Values of 22.2 and 23.7 ergs/sq cm were obtained for the specific surface free energy of an ice-water interface on the basal and prism faces of an ice lattice, respectively, at −40C. It is shown that the neglect of edge contributions to the free energy of formation of an ice embryo may have resulted in some underestimation in values of the specific surface free energy obtained by previous investigators through the fitting of theoretical nucleation rate expressions to experimental data on the freezing of pure water. The theoretical results for the free energy of formation of an ice embryo are incorporated into framework of quasi-thermodynamic nucleation theory and curves for the mean freezing temperature of pure water droplets as a function of droplet diameter are calculated for several cooling rates. Author

**N71-33299+** RAND Corp., Santa Monica, Calif.
**AIR POLLUTION**
R. A. Papetti and F. R. Gilmore Feb. 1971 35 p refs Submitted for publication
(P-4571) Avail: NTIS

Air pollution sources, distribution, harmful effects, and mathematical modelling are discussed. Particulate matter, oxides of sulfur, photochemical smog constituents, carbon monoxide, and metal pollutants are included. A brief resume of air pollution meteorology is also presented. J.M.

**N71-33313#** Lamont-Doherty Geological Observatory, Palisades, N.Y.
**[GRAVITY WAVES AND INFRASOUND RESEARCH] Final Report, 1 Mar. 1967 – 28 Feb. 1971**
William L. Donn 1971 16 p refs
(Contract DAHC04-67-C-0037)
(AD-724179; AROD-6997-23-EN) Avail: NTIS CSCL 4/1

The report summarizes the results of studies of (1) acoustic-gravity waves which included the neutral atmosphere and ionospheric effects; (2) coupling between gravity waves and the sea surface; and (3) infrasound from artificial and natural sources including rocket infrasound at short and long range, sound from Apollo rockets in space, coupling of infrasound to seismic waves in the ground and infrasound from natural sources. The report also presents a bibliography of the results. Author (GRA)

**N71-33324#** Belgian Royal Observatory, Uccle.
**STATION: LONGYEARBYEN (SPITSBERGEN). MEASUREMENTS OF THE THREE COMPONENTS MADE BY SIX HORIZONTAL PENDULUMS VM AND THREE ASKANIA GRAVIMETERS [STATION: LONGYEARBYEN (SPITSBERGEN). MESURES FAITES DANS LES TROIS COMPOSANTES AVEC SIX PENDULES HORIZONTAUX VM ET TROIS GRAVIMETRES ASKANIA]**
Manfred Bonatz, Paul Melchoir, and Bernard Ducarme Jun. 1971 110 p In FRENCH
(Bull-4/1) Avail: NTIS

Gravimetric and pendulum data tables presented contain voltage, force, and velocity measurements of terrestrial tides obtained at an Arctic station. Observed are terrestrial diurnal amplitude maxima, semi-diurnal sector amplitudes, and zonal waves of long periodicity and maximum amplitude. Transl. by G.G.

**N71-33333#** Belgian Royal Observatory, Uccle.
**SIXTH INTERNATIONAL SYMPOSIUM ON TERRESTRIAL TIDES [SIXIEME SYMPOSIUM INTERNATIONAL SUR LES MAREES TERRESTRES]**
Rene Dejaiffe, ed. 1970 277 p refs Partly in ENGLISH, partly in FRENCH, and partly in GERMAN Proc. of the Symp. held at Strasbourgh, 15–20 Sep. 1969 *Its* Commun. Ser. A, No. 9; Geophys. Ser. No. 96
Avail: NTIS

Conference papers are presented on earth tides. For individual titles see N71-33334 20-13 to N71-33371 20-13. ESRO

**N71-33334#** Belgian Royal Observatory, Uccle.
**REPORT OF THE DIRECTOR OF THE INTERNATIONAL EARTH TIDE CENTER [RAPPORT DU DIRECTEUR DU CENTRE INTERNATIONAL DES MAREES TERRESTRES]**
P. Melchior *In its* 6th Intern. Symp. on Terrest. Tides 1970 p 10–13 In FRENCH (See N71-33333 20-13)
Avail: NTIS

A survey is presented of the work carried out at the International Earth Tide Center. The results of a method using harmonic analysis are discussed. ESRO

**N71-33335#** Kyoto Univ. (Japan). Inst. of Geophysics.
**OBSERVATION OF TIDAL VARIATION OF GRAVITY MADE IN SYOWA STATION, ANTARCTICA**
Ichiro Nakagawa, Seiichi Kakinuma (Geograph. Surv. Inst.), Keizo Yanai (Tohoku Univ.), and Yasoichi Endo (Hokkaido Univ.) *In* Belg. Roy. Obs. 6th Intern. Symp. on Terrest. Tides 1970 p 16–19 (See N71-33333 20-13)
Avail: NTIS

The observations, using a LaCoste gravimeter G-118, were carried out by visual reading at about one hour intervals during a period of seven days from June 18, 07 h to June 25, 07 h, 1968 (UT), the number of readings being 169. The data obtained and the corresponding computed tides on a perfectly rigid earth were analyzed by the least squares methods and were compared with each other. It was found that the tidal factors of gravity and phase lag are 1376 and −3 deg 73 for K1 constituent, and 1145 and −3 deg 16 for O1 constituent, respectively. Author (ESRO)

**N71-33336#** Paris Univ. (France). Inst. de Physique du Globe.
**STUDY OF THE CLINOMETRIC TIDE AT A STATION IN**

**THE CENTER OF THE SAHARA: PRELIMINARY RESULTS [ETUDE DE LA MAREE D'INCLINAISON DANS UNE STATION SITUEE AU CENTRE DU SAHARA: RESULTATS PRELIMINAIRES]**

P. A. Blum *In* Belg. Roy. Obs. 6th Intern. Symp. on Terrest. Tides 1970 p 21–22 refs In FRENCH (See N71-33333 20-13)

Avail: NTIS

Results are presented of a series of 2882 clinometric observations made at a station in the Algerian Sahara. Nine diurnal waves and six semidiurnal waves have been processed. ESRO

**N71-33337#** Strasbourg Univ. (France). Inst. de Physique du Globe.

**FIRST RESULTS OF A MEASUREMENT CAMPAIGN OF THE CLINOMETRIC TIDE IN THE EASTERN PART OF FRANCE [PREMIERS RESULTATS D'UNE CAMPAGNE DE MESURE DE LA MAREE CLINOMETRIQUE DANS L'EST DE LA FRANCE]**

R. Lecolazet, L. Steinmetz, and G. Wwittlinger *In* Belg. Roy. Obs. 6th Intern. Symp. on Terrest. Tides 1970 p 23–26 refs In FRENCH; ENGLISH summary (See N71-33333 20-13)

Avail: NTIS

The amplitudes and phase displacements observed in Savonnieres (the Eastern part of the Bassin Parisien) are similar to those observed in Warmifontaine (Southern Belgium) and Villers-Adam (near Paris). The results concerning the Vosges station (Ste Marie-aux-Mines and Bussang) are clearly different. The Bussang results, in particular, offer a very important phase lag (North South component). Author (ESRO)

**N71-33338#** Belgian Royal Observatory, Uccle.

**SIMULTANEOUS OBSERVATIONS OF EARTH TIDES WITH FOUR ASKANIA AND TWO LACOSTE AND ROMBERG GRAVIMETERS IN MIZUSAWA**

*In its* 6th Intern. Symp. on Terrest. Tides 1970 p 27–29 (See N71-33333 20-13)

Avail: NTIS

A simultaneous gravimetric survey involving four Askania and two Lacoste Romberg gravimeters has been carried out for the purpose of calibrating scale constant of each instrument and comparing their characteristics. Yearly mean values are discussed. ESRO

**N71-33339#** Belgian Royal Observatory, Uccle.

**REPORT ON SOME INVESTIGATIONS CONCERNING GRAVIMETER RECORDINGS IN FRANKFURT a. M.**

R. Brein *In its* 6th Intern. Symp. on Terrest. Tides 1970 p 30–36 refs (See N71-33333 20-13)

Avail: NTIS

A method of photographic recording with gravimeters has been developed using an electric spring on the gravimeter. Calibration problems are discussed, including thermostatization and influence of air pressure. Comparisons are made of results gained with two different types of gravimeter. ESRO

**N71-33342#** Kyoto Univ. (Japan). Inst. of Geophysics.

**SOME PROBLEMS ON EARTH TIDES OBSERVED WITH A GRAVIMETER**

Ichiro Nakagawa and Masanori Shiraki (Kakioka Magnetic Obs.) *In* Belg. Roy. Obs. 6th Intern. Symp. on Terrest. Tides 1970 p 42–49 refs (See N71-33333 20-13)

Avail: NTIS

Lecolazet's, the least squares, and Fourier integrals methods of analyses of earth tides were compared with each other using one month's data obtained with an Askania gravimeter in Kyoto, Japan. Both a modified Lecolazet method to exclude systematic errors of analysis and the least squares method give excellent results in gravimetric factor and phase lag, using hourly values covering the duration of one month. Observational data obtained in Kyoto (December 1967 to March 1968) and those in Mizusawa (November 1967 to February 1968) were analyzed continuously by means of the modified Lecolazet method. These analyses show a similar variation in gravimetric factor and phase lag, and it is considered to be a part of seasonal variation in comparison with the previous observation made in Kyoto (August 1959 to August 1960). Further, the present results for gravimetric factor give greater values in general than the previous ones. This suggests secular change or long period variation in gravimetric factor. Author (ESRO)

**N71-33343#** Lamont Geological Observatory, Palisades, N. Y.

**TIDAL GRAVITY MEASUREMENTS ALONG A TRANSCONTINENTAL PROFILE ACROSS THE UNITED STATES**

John T. Kuo, Robert C. Jachens, Gale White, and Maurice Ewing *In* Belg. Roy. Obs. 6th Intern. Symp. on Terrest. Tides 1970 p 50–60 refs (See N71-33333 20-13)

(Grants NSF-GA-418; NSF-GA-16478)

Avail: NTIS

The results from analyzing data obtained from the network of a transcontinental profile for the principal tidal constituents M sub 2 and O sub 1 have shed light on the long-standing problem of the predominant indirect influence of ocean tides on the earth tidal theory. The observed values of the gravimetric factor and phase were found to depend on the tidal characteristics of the Atlantic and Pacific oceans. There are no observable correlations between tidal gravity parameters and regional geology. By taking into account the influence of ocean tides only, the gravimetric facts and phases for all the transcontinental stations, for the first time, can be brought into a consistent system in the framework of the earth tidal theory. Since the knowledge of tides on the open oceans is very limited it is appropriate to consider the possibility of mapping ocean tides on the open oceans by means of extended earth tidal gravity measurements on the adjacent lands. Author (ESRO)

**N71-33344#** Belgian Royal Observatory, Uccle.

**TIDAL TO SEISMIC FREQUENCY INVESTIGATIONS WITH A QUARTZ ACCELEROMETER OF NEW GEOMETRY**

Barry Block and Robert D. Moore *In its* 6th Intern. Symp. on Terrest. Tides 1970 p 61–72 refs (See N71-33333 20-13)

Avail: NTIS

A wide band, tidal and seismic frequency accelerometer was developed with a simple internal geometry and low drift. Initial tidal and earth mode frequency investigations are described, along with design features and internal noise measurements. Author

**N71-33345#** Belgian Royal Observatory, Uccle.

**TIDAL TILTS IN THE TIEN-SHAN**

S. M. Fandjushina *In its* 6th Intern. Symp. on Terrest. Tides 1970 p 73–83 refs (See N71-33333 20-13)

Avail: NTIS

Observation of tidal tilts in the Tien-Shan started in 1955 and had, as the primary aim, the study of slow crustal movements and of possible forerunners of earthquakes. The results of the analysis of the tidal pair of tiltmeter observations carried out are discussed. ESRO

**N71-33346#** Belgian Royal Observatory, UCCLE.

**TIDAL TILTS AT THE EAST GERGANA**

V. N. Yakovlev *In its* 6th Intern. Symp. on Terrest. Tides 1970 p 84–85 (See N71-33333 20-13)

Avail: NTIS

Results of earth tide observations by means of tiltmeters, carried out in the Eastern part of the Fergana Valley (USSR) during a period of two years from spring 1964 until spring 1966, are discussed. ESRO

N71-33347# Belgian Royal Observatory, Uccle.
**OBSERVATIONS OF TIDAL GRAVITY VARIATIONS IN ASIAN REGIONS OF THE USSR**
N. N. Pariisky, S. N. Barsenkov, V. A. Volkov, D. G. Gridnev, M. V. Kuznetsov et al *In its* 6th Intern. Symp. on Terrest. Tides 1970 p 86–89 refs (See N71-33333 20-13)
Avail: NTIS

Observations of tidal gravity variations in Middle Asia began in 1958 by means of two gravimeters. A total of 8.3 instrument-year observations are analyzed. ESRO

N71-33348# Belgian Royal Observatory, Uccle.
**TIDAL TILTS OF THE EARTH BY OBSERVATIONS IN THE USSR**
A. E. Ostrovsky and P. S. Matveev *In its* 6th Intern. Symp. on Terrest. Tides 1970 p 90–94 refs (See N71-33333 20-13)
Avail: NTIS

Observation of tidal tilts on the territory of the USSR in a great number of points located in different geological and geographic conditions have shown that the main reason for the difference of amplitudinal factor gamma at different points is explained by mechanical properties of mountain rocks where the chamber was set for observation of tidal tilts. Great local anomalies of gamma are obtained from observations in mountain openings in the shafts and adits made in rigid rocks. The least scatter in gamma is obtained from observations in shafts made in soft rocksands and clays. The second reason for scatter of the value gamma n observations at different points is variation of air temperature and heating of soil roughness by the sun. An especially great temperature effect is introduced to the component N-S. The mean value of the amplitudinal factor calculated by observations at 28 points on the USSR territory appeared to be close to 0.7, or more exact gamma = 0.683 + or −0.007. Author (ESRO)

N71-33349# Belgian Royal Observatory, Uccle.
**SLOW AND TIDAL DEFORMATION OF THE EARTH SURFACE ACCORDING TO TILT OBSERVATIONS AT THE SAYANY STATION**
I. A. Shirokov and A. E. Ostrovski *In its* 6th Intern. Symp. on Terrest. Tides 1970 p 95–96 refs (See N71-33333 20-13)
Avail: NTIS

Observations carried out at the Sayany tilt station in the geometric center of Asia are discussed. These observations solved two problems: discovery and quantitative estimation of recent slow deformations developing in tectonic zones and determination of values of the amplitudinal factor and the phase lag for main waves of the earth tide. ESRO

N71-33350# Belgian Royal Observatory, Uccle.
**ON THE EFFECT OF TEMPERATURE ON TIDAL TILTS OF THE EARTH SURFACE**
K. M. Anokhina and A. E. Ostrovsky *In its* 6th Intern. Symp. on Terrest. Tides 1970 p 97–100 refs (See N71-33333 20-13)
Avail: NTIS

Variations of the gamma factor from a 13 months series of observations of tidal tilts are analyzed. The parameters affecting the changes of this value from month to month are discussed. ESRO

N71-33351# Paris Univ. (France). Inst. de Physique du Globe.
**REGIONAL STUDY OF THE OCEAN INFLUENCE ON CLINOMETRY. FIRST RESULTS AT THE MOULIS STATION [ETUDE REGIONALE DE L'INFLUENCE OCEANIQUE SUR L'INCLINAISON. PREMIERS RESULTATS A LA STATION DE MOULIS]**
P. A. Blum and D. Hatzfeld *In* Belg. Roy. Obs. 6th Intern. Symp. on Terrest. Tides 1970 p 102–105 refs In FRENCH (See N71-33333 20-13)
Avail: NTIS

Continuous recordings over a period of 18 months have been carried out at the Moulis (France) clinometric station. Numerical analysis has been performed by means of several computer programs. Part of the resulting scattering is attributed to the influence of the Atlantic Ocean. ESRO

N71-33352# Dominion Observatory, Ottawa (Ontario).
**SOME NUMERICAL RESULTS IN THE DETERMINATION OF THE INDIRECT EFFECT**
D. R. Bower *In* Belg. Roy. Obs. 6th Intern. Symp. on Terrest. Tides 1970 p 106–112 refs (See N71-33333 20-13)
Avail: NTIS

The principal disturbance in earth-tide measurements is due to attraction effects of the ocean tide. An improved method for predicting these indirect effects at a given location is presented. ESRO

N71-33353# Belgian Royal Observatory, Uccle.
**THE EFFECT OF OCEAN TIDES UPON EARTH-TIDE OBSERVATIONS**
B. P. Pertsev *In its* 6th Intern. Symp. on Terrest. Tides 1970 p 113–114 refs (See N71-33333 20-13)
Avail: NTIS

Secondary effects of ocean tides upon earth-tide observations were evaluated using cotidal charts. The method used can only take into account effects of seas situated further than 1500 km, but this effect is shown to be not negligible. ESRO

N71-33354# Belgian Royal Observatory, Uccle.
**STUDY OF DIFFERENT TYPES OF HORIZONTAL PENDULUM DRIFT OBSERVED AT THE STATION OF KANNE (LIEGE UNIV.) BETWEEN 1966 AND 1969, IN THE EAST-WEST DIRECTION [ETUDE DE LA DERIVE DE PENDULES HORIZONTAUX DE TYPES DIFFERENTS OBSERVEE A LA STATION DE KANNE (UNIV. DE LIEGE) DE 1966 A 1969, EN COMPOSANTE E.ST-OUEST]**
L. Bragard *In* Belg. Roy. Obs. 6th Intern. Symp. on Terrest. Tides 1970 p 117–135 refs In FRENCH; ENGLISH summary (See N71-33333 20-13)
Avail: NTIS

The observations show the main influence of an instrumental cause (square screw and sensitivity lever) and the intermittent influence of a geophysical cause (sudden variations of the atmospheric pressure) in the phenomena of the tilt drift. Author (ESRO)

N71-33355# Belgian Royal Observatory, Uccle.
**CORRECTION OF EARTH-TIDE OBSERVATIONS TAKING INTO ACCOUNT INDIRECT EFFECTS AS A BOUNDARY VALUE PROBLEM [DIE KORREKTUR VON ERDGEZEITEN-BEOBACHTUNGEN AUF INDIREKTE EFFEKTE ALS RANDWERTPROBLEM DER MECHANIK]**
W. Buchheim *In* Belg. Roy. Obs. 6th Intern. Symp. on Terrest. Tides 1970 p 137–146 refs In GERMAN (See N71-33333 20-13)
Avail: NTIS

A survey is presented of the main problems occurring by earth-tide observations and their correction due to indirect effects. A three-step program is presented to improve measurements, assuming drift-free instruments. ESRO

N71-33356# Belgian Royal Observatory, Uccle.
**RESULTS OBTAINED FOR M3 WAVE [RESULTATS OBTENUS POUR L'ONDE M3]**
P. Melchior *In its* 6th Intern. Symp. on Terrest. Tides 1970 p 148–149 ref In FRENCH (See N71-33333 20-13)
Avail: NTIS

Results of a great number of observations of the M3 wave from the periodic deformation of the earth are analyzed. Data has been gathered by 21 different instruments over 23.504 days. These results are compared with different models. The Takeuchi model seems to be the most accurate. ESRO

N71-33357# Kyoto Univ. (Japan).
**SHIDA'S NUMBER OBTAINED BY EXTENOMETRIC OBSERVATIONS IN KAMITAKARA, JAPAN**
Ichiro Nakagawa, Hikaru Doi, and Kazuo Oike *In* Belg. Roy. Obs. 6th Intern. Symp. on Terrest. Tides 1970 p 150–153 (See N71-33333 20-13)
Avail: NTIS

Observations were carried out during 1966–1967 by means of strain seismographs, long period seismographs, tiltmeters of various types and gravimeters. A preliminary report is presented of a trial to determine a value of the Shida number using data obtained by an observation of the earth strain. ESRO

N71-33358# California Univ., La Jolla. Inst. of Geophysics and Planetary Physics.
**A LASER EARTH STRAIN METER**
Jon Berger and R. H. Lovberg *In* Belg. Roy. Obs. 6th Intern. Symp. on Terrest. Tides 1970 p 154–162 refs (See N71-33333 20-13)
Avail: NTIS

A laser interferometer for the study of earth strain is described. Changes in the length of an 800-m arm are measured by counting fringes in the interference pattern with a least count of 4 x 10 to the −10 power. The output is linear and has a flat response from DC to 1 MHz and a dynamic range of 1,000,000. The laser wavelength is controlled by reference to a passive optic resonator contained in a stable environment. The wavelength stability is a few parts in 10 to the 10th power for periods up to a laser lifetime (approximately 3000 hr). Author (ESRO)

N71-33359# Kyoto Univ. (Japan). Inst. of Geophysics.
**TIDAL OSCILLATION OF HALEMAUMAU LAVA LAKE, KILAUEA, HAWAI AND ITS IMPLICATION FOR EXISTENCE OF A MAGMA RESERVOIR**
Daisuke Shimozuru and Ichiro Nakagawa *In* Belg. Roy. Obs. 6th Intern. Symp. on Terrest. Tides 1970 p 1631–166 refs (See N71-33333 20-13)
Avail: NTIS

Levels of the Hawaiian Halemaumau lava lake have been observed in conjunction with earth tides. It is shown that the observed semidiurnal tides of the lava lake might have been caused by squeezing out and draining back of magma from a magma reservoir through a conduit as a result of volume change of the magma reservoir due to earth tides. ESRO

N71-33360# Institute of Coastal Oceanography and Tides B, Bidston (England).
**AN ANALYTICAL TECHNIQUE TO MINIMIZE NOISE IN A SEARCH FOR LINES IN THE LOW FREQUENCY SPECTRUM**
Petr Vanicek *In* Belg. Roy. Obs. 6th Intern. Symp. on Terrest. Tides 1970 p 170–173 refs (See N71-33333 20-13)
Avail: NTIS

An optimization process using the least square fit as a criterion was first tested in analyzing the drift of a pair of horizontal pendulums. A further extension of the technique is proposed for spectral analysis. Two variants of the frequency transform have been tested in analyzing five months of continuous observations by a pendulum. ESRO

N71-33361# Environmental Science Services Administration Miami, Fla. Atlantic Oceanographic and Meteorological Lab.
**TIDAL CONSTANTS DERIVED FROM RESPONSE ADMITTANCES**
B. Zetler, D. Cartwright (Natl. Inst. of Oceanog., U.K), and W. Munk (California Univ., San Diego) SI *In* Belg. Roy. Obs. 6th Intern. Symp. on Terrest. Tides 1970 p 175–178 refs (See N71-33333 20-13)
Avail: NTIS

The response method of tide prediction has previously been applied to various observed series to obtain frequency-dependent admittances that describe the tidal characteristics in a similar sense to what can be deduced from traditional harmonic constants. To bridge the gap between the two methods of presentation, procedures are described on how to derive harmonic constants from the response admittances and one method is applied to a set of observed data. Author (ESRO)

N71-33362# Institute of Coastal Oceanography and Tides, Bidston (England).
**THEORY OF MOTION OF HORIZONTAL PENDULUM WITH ZOLLNER SUSPENSION**
Petr Vanicek *In* Belg. Roy. Obs. 6th Intern. Symp. on Terrest. Tides 1970 p 180–182 refs (See N71-33333 20-13)
Avail: NTIS

The changes in the free oscillatory period of a horizontal pendulum with Zollner suspension has been investigated from an experimental point of view. An attempt is presented to throw light on the phenomenon from a theoretical aspect. ESRO

N71-33363# Institute of Coastal Oceanography and Tides, Bidston (England).
**CALIBRATION TESTS AND THE COMPARATIVE PERFORMANCE OF HORIZONTAL PENDULUMS AT A SINGLE STATION**
G. W. Lennon and P. Vanicek *In* Belg. Roy. Obs. 6th Intern. Symp. on Terrest. Tides 1970 p 183–193 refs (See N71-33333 20-13)
Avail: NTIS

A number of pendulums and seismographs have been used at the same station and a comparative assessment of their performance obtained. Calibration problems together with instrumental mounting and interface with a natural rock surface are discussed. Preliminary results obtained are tabulated. ESRO

N71-33364# Belgian Royal Observatory, Uccle.
**ON THE ACCURACY OF CLINOMETRIC EARTH TIDE OBSERVATIONS [SUR LA PRECISION DES OBSERVATIONS CLINOMETRIQUES DE MAREES TERRESTRES]**
P. Melchior *In its* 6th Intern. Symp. on Terrest. Tides 1970 p 193–196 refs In FRENCH (See N71-33333 20-13)
Avail: NTIS

Systematic or accidental errors occurring in clinometrical measurements of earth tides are discussed, in particular, errors due to definition of the true azimuth, sensitivity of measurements, and installation problems. ESRO

N71-33365# Belgian Royal Observatory, Uccle.
**CALIBRATION OF A GRAVIMETER BY USING A HEAVY MASS**

Erwin Groten *In* Belg. Roy. Obs. 6th Intern. Symp. on Terrest. Tides 1970 p 197–202 ref (See N71-33333 20-13)
Avail: NTIS

The determination of the calibration factor of a recording gravimeter using a heavy steel or brass ball is described. A system of several balls can be used too. In order to do the calibration under usual operational conditions, i.e. without any modification of the sealed meter, a small elevator is used. The aim of the procedure is a calibration where the measuring screw is not involved and which can be applied in the station without removing the gravimeter. In principle, this measurement procedure could be used for the study of the lag effects in gravimeter recording too. However, due to the relatively small attractional effect produced by the ball measurements of very high accuracy are needed. This is a disadvantage of the procedure. Nevertheless, an accuracy of + or −0.001 for the calibration factor is feasible at the present state of the art. Author (ESRO)

**N71-33366#** Belgian Royal Observatory, Uccle.
**LAG PHASE EXPERIMENTAL DETERMINATION OF TIDAL WAVE IN THE CASE OF ASKANIA GRAVIMETERS [DETERMINATION EXPERIMENTALE DU DEPHASAGE DES ONDES DE MAREE DANS LE CAS DES GRAVIMETRES ASKANIA]**
B. Ducarme *In* Belg. Roy. Obs. 6th Intern. Symp. on Terrest. Tides 1970 p 203–205 refs In FRENCH (See N71-33333 20-13)
Avail: NTIS

Phase lag obtained when analyzing tidal wave observations are altered by an additional lag due, for example, to the galvanometer. The value of this additional lag is discussed from experimental observations. ESRO

**N71-33367#** Belgian Royal Observatory, Uccle.
**THE EFFECT OF PHASE CHARACTERISTICS OF ASKANIA GRAVIMETERS UPON MEASUREMENTS OF PHASE LAGS IN TIDAL OBSERVATIONS**
V. A. Volkov and N. N. Pariisky *In* Belg. Roy. Obs. 6th Intern. Symp. on Terrest. Tides 1970 p 206–209 refs (See N71-33333 20-13)
Avail: NTIS

Determination of lagging of the observed earth tides in relation to the theoretical one have been carried out by five different Askania gravimeters at different times and by three different methods. ESRO

**N71-33368#** Belgian Royal Observatory, Uccle.
**NOTE ON THE FREQUENCY OF DETERMINATION OF SCALE OF RECORDING EARTH TIDE OBSERVATIONS BY ASKANIA GRAVIMETER [NOTE SUR LA FREQUENCE DE LA DETERMINATION DE L'ECHELLE DE L'ENREGISTREMENT DANS LES OBSERVATIONS DES MAREES TERRESTRES PAR LE GRAVIMETRE ASKANIA]**
P. S. Korba *In* Belg. Aoy. Obs. 6th Intern. Symp. on Terrest. Tides 1970 p 210–212 refs In FRENCH (See N71-33333 20-13)
Avail: NTIS

Starting from observations of gravity variations due to tides an attempt is made to approximate the optimal frequency of the scale determination of the recording giving the best accuracy. A record of nine months' observations is analyzed. ESRO

**N71-33369#** Uppsala Univ. (Sweden). Inst. of Solid Earth Physics.
**A HORIZONTAL PENDULUM STATION WITH TILT COMPENSATION**
Andreas Vogel *In* Belg. Roy. Obs. 6th Intern. Symp. on Terrest. Tides 1970 p 213-215 refs Sponsored by Swed. Council of Nat. Sci. Res. (See N71-33333 20-13)
Avail: NTIS

A method to calibrate horizontal pendulums using bearing plates which are affected by pressure in a mercury tube is described. The mercury tube is lowered or raised to adjust the level and thereby bring the pendulum beam back to its zero position. ESRO

**N71-33370#** Belgian Royal Observatory, Uccle.
**DETERMINATION OF INFLUENCE OF LONG TERM EARTH TIDES ON THE EARTH ROTATION [LA DETERMINATION DE L'INFLUENCE DES MAREES TERRESTRES SUR LA ROTATION DE LA TERRE]**
Anna Stoyko and Nicolas Stoyko *In* Belg. Roy. Obs. 6th Intern. Symp. on Terrest. Tides 1970 p 222–225 refs In FRENCH (See N71-33333 20-13)
Avail: NTIS

The influence of earth tides on earth rotation is discussed, taking into account variations of the value of astronomical constants. The variation of the earth's rotation is due to earth tide caused by the motion of the lunar orbit nodes. ESRO

**N71-33371#** Belgian Royal Observatory, Uccle.
**ON TIDAL EFFECTS IN SATELLITE GRAVITY DATA**
Erwin Groten *In* Belg. Roy. Obs. 6th Intern. Symp. on Terrest. Tides 1970 p 228–233 refs (See N71-33333 20-13)
Avail: NTIS

The effect of the yielding of the earth due to luni-solar tidal acceleration on geodetic data as obtained from satellite orbit analysis is discussed. Differences between terrestrial and satellite gravity data are pointed out. The influence of the duration of stress on Love's numbers h and k is considered. Author (ESRO)

**N71-33374*#** Geological Survey, Denver, Colo.
**GEOLOGIC EVALUATION OF ANOMALIES BETWEEN LIKE-POLARIZED AND CROSS-POLARIZED K-BAND SIDE-LOOKING RADAR IMAGERY OF YELLOWSTONE NATIONAL PARK, 1965**
Gerald M. Richmond [1970] 35 p refs
(NASA Order W-13165)
(NASA-CR-121419; NASA-165) Avail: CSCL 08E

Surface geology anomalies noted between like-polarized and cross-polarized side-looking K-band radar imagery recorded over Yellowstone National Park and the northern part of Grand Teton National Park are analyzed. The imagery was flown in the fall of 1965. The flight strips are in a generally north-south direction and the direction of view is to the east and west alternately. Author

**N71-33376#** Environmental Protection Agency, Research Triangle Park, N.C. Office of Air Programs.
**GUIDE FOR AIR POLLUTION EPISODE AVOIDANCE**
Jun. 1971 150 p refs
(Contract PH-22-68-32)
(AP-76) Avail: SOD $0.70

General guidelines are presented to assist air pollution control officials and local governmental authorities in formulating and implementing emergency action plans for avoidance of pollution episodes. An air pollution episode is defined as the occurrence of stagnant air masses during which air pollutants accumulate so as to expose the population to an elevated concentration of airborne contaminants. Accidental episodes, such as emergencies resulting from the rupture of chemical vessels or transport lines are not considered. The discussion includes the planning required to forestall the adverse effects of such events, despite differences in legal, and administrative frameworks and environmental conditions over

various regions. Requirements common to all areas include the need for: (1) information on emission sources; (2) data on the area's weather patterns and meteorological conditions and; (3) action plans for recognizing potentially severe episodes and coping with them. Planning, technical, social, economic, legal, and administrative factors of importance in episode avoidance and control activities, as well as in the establishment of an action center are discussed in detail. A.C.R.

**N71-33377#** Environmental Protection Agency, Research Triangle Park, N.C. Office of Air Programs.
**GUIDE FOR CONTROL OF AIR POLLUTION EPISODES IN MEDIUM SIZED URBAN AREAS**
Jun. 1971 60 p
(Contract PH-22-68-32)
(AP-77) Avail: SOD $0.40

Specific details are supplied for designing and implementing emergency actions plans for avoiding air pollution events in medium-sized urban areas. They are directed toward the needs of medium-to-large cities and possibly to state air pollution control programs. It is emphasized that although the character of a town with a population of 30,000 is quite different from a metropolis populated by 300,000, moderately sophisticated plans are required to serve the needs of such communities. Support of a competent, full-time staff, operating with the latest automatic sampling devices is recommended where possible, but cities should be capable of implementing effective emergency plans with a handfull of trained personnel in any case. This requires joint planning and implementation effort between the control authority and the personnel who operate emission sources. A.C.R.

**N71-33378#** Environmental Protection Agency, Research Triangle Park, N.C. Office of Air Programs.
**GUIDE FOR CONTROL OF AIR POLLUTION EPISODES IN SMALL URBAN AREAS**
Jun. 1971 66 p refs
(Contract PH-22-68-32)
(AP-78) Avail: SOD $0.40

Detailed information is provided for control of air pollution episodes in small urban areas with a nominal population of 10,000 to 30,000. Such areas cannot be expected to have a highly sophisticated control authority and often must rely on the state agency for overall guidance. Limited but effective control actions can be taken in any area, however, even if complex air quality monitoring capabilities and other specialized technical expertise are not immediately available. A.C.R.

**N71-33387#** Belgian Royal Observatory, Uccle.
**THE GRAVIMETRY AT THE ROYAL OBSERVATORY OF BELGIUM**
B. Ducarme 1970 20 p refs In FRENCH; ENGLISH summary
Avail: NTIS

The earth's gravity field is examined according to three main topics: absolute measurements, variations at the surface and periodic changes of g under the action of the Sun and of the Moon. These gravimetric tides are studied at the Royal Observatory of Belgium since the I.G.Y. in connection with the internal constitution of the Earth. Author

**N71-33392*#** Iowa Univ., Iowa City. Dept. of Physics and Astronomy.
**LVF HISS AND RELATED PLASMA OBSERVATIONS IN THE POLAR MAGNETOSPHERE Progress Report, May 1971**
Donald A. Gurnett and Louis A. Frank May 1971 59 p refs
Sponsored in part by Navy
(Contracts NAS5-10625; NAS1-8141; NAS1-8144(f); NAS1-8150(f); Grant NGL-16-001-043(97) et al)
(NASA-CR-121418; Rept-71-19) Avail: NTIS CSCL 03B

Auroral zone VLF hiss and low energy charged particle observations with the Injun 5 satellite are presented. The results provide the first direct verification of the association between auroral zone VLF hiss and intense fluxes, 10,000 to 10 to the minus 7th power electrons (sq cm-sec-sr-eV), of low energy electrons with energies on the order of 100 eV to several keV. On the dayside of the magnetosphere, these low energy electrons are identified with the dayside polar cusp region. At other local times, the VLF hiss and low energy electron precipitation regions are believed to correspond to the extension of the dayside polar cusp into the distant plasma sheet and downstream magnetosheath on the nightside of the magnetosphere. On the basis of present models, the observed VLF hiss intensities cannot be accounted for by incoherent Cerenkov radiation from the observed electron fluxes, indicating that a coherent plasma instability mechanism is involved in some, if not all, of the VLF hiss generation. Author

**N71-33434#** Ionospharen-Institut Breisach (West Germany).
**IONOSPHERIC DATA: VERTICAL ECHO SOUNDING, FREIBURG (URSI CODE 131) [IONOSHAEREN-DATEN: VERTIKAL-ECHO-LOTUNG, FREIBURG (URSI-CODE 131)]**
Apr. 1971 44 p In GERMAN and ENGLISH
(Rept-298-F) Avail: NTIS

Daily summaries are presented for vertical echo sounding of the upper atmosphere over Freiburg, Germany during April, 1971. The data include charts of medium values for the E and F regions, MUF(3000)F2, M(3000)F2, h'F2, hpF2, foF1, MUF(3000)F1, M(3000)F1, h'F, foE, foE2, h'E, foEs, fbEs, h'Es, Type Es, foT, and fmin. Author

**N71-33442*#** National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
**THE DEGENERATION OF THE HOUGH FUNCTIONS WITHIN THE THERMOSPHERE**
H. Volland (Bonn Univ.) and H. G. Mayr Aug. 1971 11 p refs Presented at 14th URSI-COSPAR Symp. on the Dyn. of the Thermosphere and Ionosphere above 120 km, Seattle, 17 Jun.-2 Jul. 1971 Submitted for publication *Its* Paper No. C.6.2
(NASA-TM-X-65675; X-621-71-331) Avail: NTIS CSCL 03B

Within the lower nondissipative atmosphere, the eigenfunctions of the atmosphere are the Hough functions which describe the tidal wave motions. Under the influence of dissipation mechanisms like heat conduction, viscosity, and neutral ion drag these Hough-functions become modified at thermospheric heights and are shown to degenerate ultimately into spherical harmonics at heights above 200 km. The implications of this degeneration on the latitudinal structure of the tidal modes and on the vertical wave propagation are discussed. It was suggested in particular that the semi-diurnal mode becomes quasitrapped at altitudes above 160 km thus explaining the apparent absence of semi-diurnal variations in the dynamics of the upper thermosphere. Author

**N71-33443*#** National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
**PROPERTIES OF THE THREE DIMENSIONAL THERMOSPHERE DYNAMICS**
H. Volland (Bonn. Univ.) and H. G. Mayr Aug. 1971 10 p refs Presented at 14th URSI-COSPAR Symp. on the Dyn. of the Thermosphere and Ionosphere above 120 km, Seattle, 17 Jun.-2 Jul. 1971 Submitted for publication *Its* Paper No. C.3.3
(NASA-TM-X-65676; X-621-71-332) Avail: NTIS CSCL 03B

Assuming spherical harmonics as the eigenfunctions of the atmosphere dynamics above 200 km altitude, a transfer function can be derived which gives the ratio between heat input component and the corresponding density component in a development into series of spherical harmonics. The transfer function has the properties of a filter suppressing low periods (smaller

than about 10 hours) and waves with small horizontal scales (n > 2). The implications of this filtering effect were discussed to show that it can explain a number of general properties in the thermosphere dynamics associated with tides, planetary waves, and magnetic disturbances. Author

N71-33497# Finnish Meteorological Office, Helsinki.
**ENERGY BALANCE OF THE EARTH'S SURFACE IN FINLAND**
Erkki Laitinen 1970 16 p refs *Its* Finn. Meteorol. Inst. Contrib. No. 76
Avail: NTIS

Monthly mean values of the components of the energy balance of the earth's surface in Finland are presented. Radiation balance is calculated from temperature, cloudiness and humidity observations. Loss of heat due to evaporation and gain or loss of heat due to freezing and thawing and to the cooling or heating of the soil were estimated based largely on existing studies. Turbulent heat exchange between the earth's surface and the atmosphere is thereafter computed as the residual from the balance equation. The annual variation of all the components is quite large, but the geographical variations are usually small. Author

N71-33521# California Univ., Livermore. Lawrence Radiation Lab.
**TESTS OF ICE AGE THEORIES USING A ZONAL ATMOSPHERIC MODEL**
Michael C. MacCracken Oct. 1970 60 p refs Sponsored by AEC
(UCRL-72803) Avail: NTIS

The formulation of a zonal atmospheric model designed to simulate the earth's climate is described, and its results are verified against present observational data. Particular attention is devoted to the Arctic Ocean energy balance and the stability of the existing ice cover. The numerical computer model is used to simulate the climate that would result from an open Arctic, and the four stages of the Ewing and Donn theory of the cause of continental glaciation are contrasted to the computed climate. Model results indicate that an ice-free Arctic Ocean is not stable and would rapidly develop an ice cover even in the absence of a surrounding continental ice sheet. Ice age theories depending on variations in the solar constant and Antarctic icecap instability are also briefly considered. Author

N71-33528# National Physical Lab., New Delhi (India). Radio Science Div.
**SOME PRELIMINARY RESULTS OF THE ROCKET SOUNDING OF THE D REGION AT THE GEOMAGNETIC EQUATOR**
Y. V. Somayajula, M. B. Avadhanulu, K. S. Zalpuri, and S. C. Garg Dec. 1970 20 p refs
(RSD-57; SR-57) Avail: NTIS

A Nike-Apache rocket (ISRO 30.01) was launched from Thumba, India, at the magnetic equator, with propagation experiments to measure the electron density, a Langmuir probe to measure electron current and electron temperatues, and a Lyman alpha sensor to determine molecular oxygen partial pressure profile for deriving electron collision frequencies. The propagation experiments used included: (1) measurement of the ordinary and extraordinary absorption on frequencies of 2365 and 3634 k Hz for transverse propagation conditions; (2) a riometer operating on 15 MHz to measure changes in the cosmic noise absorption in passage through the D-region. A preliminary electron density distribution derived from the propagation and probe experiments and its interpretation was presented. Author

N71-33537# Edgerton, Germeshausen and Grier, Inc., Santa Barbara, Calif.
**ENVIRONMENTAL AIR QUALITY SUPPORT STUDY. ACCOMPLISHMENTS THROUGH FY 1970**
T. W. Nybakken Jul. 1970 24 p refs Sponsored by AEC
(EGG-1183-2242) Avail: NTIS

The problem of environmental air quality is examined. The major serious pollutants considered are ozone, nitrogen oxides, sulfur oxides, and oxides of carbon. Considerations are presented for the development of global air quality standards. A worldwide system of surveillance and monitoring is suggested using a long range jet aircraft as the mobile instrument platform. Author

N71-33540# Los Alamos Scientific Lab., N.Mex.
**LIGHT SCATTERING FROM AEROSOLS**
B. R. Suydam Feb. 1971 7 p refs
(Contract W-7405-eng-36)
(LA-4641) Avail: NTIS

Light scattering from an aerosol of "Farmington" particles, consisting of thin shelled dielectric spheres, is calculated for two assumed particles distribution functions. For comparison scattering from solid dielectric spheres has also been computed for the same distribution function. The results are quite sensitive to choice of distribution functions, and to the nature of the particles, whether solid or hollow. Author

N71-33563*# Rice Univ., Houston, Tex. Dept. of Space Science.
**APPLICATIONS TECHNOLOGY SATELLITE (ATS-1) SUPRATHERMAL ION DETECTOR EXPERIMENT (SID) DATA REDUCTION AND ANALYSIS Final Report, 6 Dec. 1966 - 30 Mar. 1970**
J. W. Freeman, Jr. and D. T. Young 1970 26 p refs
(Contract NAS5-9561)
(NASA-CR-121452) Avail: NTIS CSCL 03B

Suprathermal Ion Detector Experiment (SID) on the ATS-1 began operation on December 10, 1966 and sent back useful data through February 16, 1967. During the more than 2 months of nearly continuous operation the SID returned data on low energy (< 50 eV) plasma flows during magnetically disturbed times which have in turn contributed to knowledge on the magnetospheric electric field. A fortuitous crossing of the magnetopause boundary at 6.6 R sub E has enabled a detailed study of low energy plasma flow at the boundary. Very low frequency plasma waves have been detected on a few occasions during magnetically disturbed times. Lastly, during magnetospheric and polar substorms the tail plasma sheet is found to penetrate to 6.6 R sub E and is a highly recurrent feature of these phenomena. Author

N71-33568*# Geological Survey, Washington, D.C.
**ANALYSIS OF A SPACE PHOTO OF A HUMID AND FORESTED REGION: A CASE STUDY OF THE TENNESSEE VALLEY Final Report**
Robert W. Peplies and James D. Wilson (East Tenn. State Univ.) Oct. 1970 72 p refs
(NASA Order W-12572)
(NASA-CR-111922; IR-USGS-206) Avail: NTIS CSCL 08G

The analysis of a space photo of a humid and forested region was concerned with identifying various types of objects of some spatial significance to the area and then observing, interpreting, and analyzing this areal data in the form of regional patterns. It is proposed that these patterns are meaningful functional units significant in the decision making process with respect to resource development and planning. It is necessary to understand the factors responsible for the spectral and spatial component parts of these units and to understand the relationships between the signatures and the characteristics of the region. Therefore, at this stage of the development of the concept, each regional unit should be treated as a unique spatial entity. Author

N71-33601# Instituto Geografico y Catastral, Madrid (Spain).
**ANNUAL OF GEOMAGNETISM AND AERONOMY FOR 1968 [ANUARIOS DEL SERVICIO DE GEOMAGNETISMO Y AERONOMIA, ANO 1968]**
1970 251 p ref In SPANISH
Avail: NTIS

The results of the systematic measurement of geomagnetic elements during 1968 are presented. Included are graphs of diurnal magnetic variations, and magnetic indices K + C. Transl. by F.O.S.

N71-33602# Instituto y Observatorio Astronomico de Marina, San Fernando (Spain).
**ANNUAL OF THE MARINE INSTITUTE AND OBSERVATORY. SECTION 3: MAGNETIC AND METEOROLOGICAL OBSERVATIONS, 1968 [ANALES DEL INSTITUTO Y OBSERVATORIO DE MARINA. SECCION 3: OBSERVACIONES METEOROLOGICAS Y MAGNETICAS, ANO 1968]**
1971 82 p In SPANISH
Avail: NTIS

The results of systematic measurements of the components of the geomagnetic field are presented along with meteorological summaries. The magnetic tables include: H, Z, and D components; declination, horizontal and vertical forces, and statistics of the diurnal variations of the three components. Transl. by F.O.S.

N71-33730# Danish Meteorological Inst., Charlottenlund.
**OCEANOGRAPHICAL OBSERVATIONS FROM DANISH LIGHT-VESSELS AND COASTAL STATIONS [OCEANOGRAFISKE OBSERVATIONER FRA DANSKE FYRSKIBE OG KYSTSTATIONER]**
1970 155 p In DANISH and ENGLISH
Avail: NTIS

Ocean current, temperature, salinity, and surface data from Danish light-vessel and coastal stations are presented in tabular form for 1970. J.M.

N71-33734# National Oceanic and Atmospheric Administration, Boulder, Colo. Atmospheric Physics and Chemistry Lab.
**DETERMINING DISTANCE TO LIGHTNING STROKES FROM A SINGLE STATION**
Lothur H. Ruhnke Jan. 1971 29 p refs
NOAA-TR-ERL-195-APCL-16) Avail: SOD $0.35

A study was made to use the differences between the decay of electric and magnetic fields near lightning strokes to determine the distance from a single station to the lightning. A model of a return stroke was used to compute the waveform of electric and magnetic fields, between 1 km and 100 km distance, and the associated frequency spectrum. From 3 km to 30 km the electric field, when observed at 1 kHz decreases approximately with the cube of the distance, while the magnetic field decreases with the square of the distance. For distances farther than 30 km, both signals decay inversely with distance. On an observation frequency of 1 kHz, it is possible to determine distances to return stroke channels between 3 km to 30 km by using the ratio of magnetic field to electric field. An instrument was designed and tested which uses loop antennas for sensing magnetic fields and horizontal wire antennas for sensing the electric field, and contains sharp filters, amplifiers, and peak voltage detectors. Author

N71-33787# Environmental Protection Agency, Research Triangle Park, N.C.
**AIR POLLUTION ASPECTS OF EMISSION SOURCES: MUNICIPAL INCINERATION, A BIBLIOGRAPHY WITH ABSTRACTS**
May 1971 101 p refs
(AP-92) Avail: SOD $1.00

A bibliography of reports on the subject of air pollution resulting from the use of municipal incinerators is presented. Approximately 320 abstracts have been chosen to cover 14 categories of air pollution. Subject and author indexes refer to the abstracts by category letter and accession number. Author

N71-33789# Weapons Research Establishment, Salisbury (Australia). Dept. of Supply.
**IONOSPHERIC DATA FOR JUNE 1970 FROM SALISBURY, SOUTH AUSTRALIA**
Apr. 1971 29 p
(WRE-SAD-1970/6/s) Avail: NTIS

Tables of the hourly values of the customary ionospheric parameters are given for the station at Salisbury for June 1970. Author

N71-33808*# Biospherics, Inc., Rockville, Md.
**SOIL MOISTURE GROUND TRUTH DATA FOR CORRELATION WITH MICROWAVE RADIATION DATA Final Report**
Obadiah P. Cohen 4 Apr. 1971 44 p
(Contract NAS5-21610)
(NASA-CR-121439) Avail: NTIS CSCL 08E

Flights over the Imperial Valley and over the Phoenix, Arizona area were conducted on February 25, 1971 and March 1, 1971. In conjunction with these flights, soil moisture samplings of various fields below the flight paths in each area for future correlation with microwave radiation temperatures were conducted. Author

N71-33827*# California Univ., Berkeley. Space Sciences Lab.
**AN INTEGRATED STUDY OF EARTH RESOURCES IN THE STATE OF CALIFORNIA USING REMOTE SENSING TECHNIQUES Progress Report**
1 Feb. 1971 196 p refs Original contains color illustrations
(Grant NGL 05-003-404)
(NASA-CR-121460) Avail: NTIS CSCL 08G

An integrated approach is presented to the study of the water resources management program of California. Factors considered include: potential users; potential managers; parameters that govern the availability of water; and the extent to which remote sensing can be used to measure hydrologic parameters in the source areas. It is recommended that a similar study be made of the coastal areas. F.O.S.

N71-33830# Danish Meteorological Inst., Charlottenlund. Geophysics Section.
**KNEE OF TOTAL ELECTRON CONTENT AND SCINTILLATION BOUNDARY**
Ib Steen Mikkelsen Feb. 1971 28 p refs *Its* Geophys. Papers No. R-21
(Contract F61052-69-C-0019)
Avail: NTIS

During local evening a knee is observed in the total electron content of the ionosphere at 60 - 70 deg invariant latitude. Over a limited longitude interval the knee is located at a fixed invariant latitude. With increasing K sub p values the knee moves southward. The southern boundary of the small scale ionospheric irregularities causing satellite scintillation shows the same behavior. None the less a detailed comparison of the two phenomena shows, that they are not closely connected. Author

N71-33839 Belgian Royal Observatory, Brussels.
**PERMANENT COMMISSION FOR TERRESTRIAL TIDES: BIBLIOGRAPHY 4, 1966 - 1969 [COMMISSION**

**PERMANENTE DES MAREES TERRESTRES: 4, 1966 – 1967]**
Aug. 1969 42 p refs In FRENCH
Avail: NTIS

The bibliography contains numerous entries of international studies on terrestrial tides. Transl. by G.G

**N71-33851#** Institut Fuer Angewandte Geodaesie, Frankfurt Am Main (West Germany).
**POSSIBILITIES FOR CARTOGRAPHIC MAPPING OF THE GRAVITY FIELD [MOEGLICHKEITEN ZUR KARTOGRAPHISCHEN DARSTELLUNG DES SCHWEREFELDES]**
Gerhard Soltau 1970 54 p refs In GERMAN; ENGLISH summary
(Rept-179) Avail: NTIS

The methods by which a test sheet (scale 1:200,000) of height-reduced gravity values was produced are described. Isogams of reduced gravity were computed and interpolated by means of electronic data processing equipment. The map was drawn on the background of the topographic survey map for Germany which was produced at a scale of 1:200,000, each sheet covering an area of 48 × 80 minutes of arc. Author

**N71-33857#** Kiruna Geophysical Observatory (Sweden).
**KIRUNA GEOPHYSICAL DATA: DATA SUMMARY 70/1–3, JANUARY–MARCH 1970**
L. Liszka, ed. Mar. 1970 140 p Prepared jointly with ESRANGE
Avail: NTIS

Data recorded at Kiruna, Sweden, during January–March 1970, relating to geomagnetic variations and storms, earth currents, auroras, cosmic noise, and ionospheric absorption are presented. ESRO

**N71-33876*#** National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
**AN ATTEMPTED MEASUREMENT OF AN O2 (1 DELTA g)–(3 SIGMA g –) NIGHTTIME EMISSION PROFILE IN A ZERO DEGREE LATITUDE REGION**
Jean Edward Welker Nov. 1970 11 p refs
(NASA-TM-X-65670; X-622-70-430) Avail: NTIS CSCL 03B

An assumption that the molecular oxygen transition behaves at night in the same way as the 5577 A transition of atomic oxygen was investigated. A radiometer was designed with the intent of observing a nighttime profile through 100 km, in conjunction with an additional daytime profile measurement with another radiometer, both in a zero degree latitude region. The nighttime radiometer had two channels, one which observed a spectral region representative of the background radiation intensity, the other which observed the spectral region in which the molecular oxygen emission was expected (centered at 1.268 microns). The radiometer looked out the side of the rocket in a direction perpendicular to the cylindrical axis and the radiometer was built with a rapid response time to allow measurements with this viewing configuration. No molecular oxygen emission radiation was seen; the minimum detectable signal level of the radiometer was 1 MR. Author

**N71-33882#** Kyoto Univ. (Japan). Research Inst. for Fundamental Physics.
**QUANTUM THEORY OF GRAVITATION VS CLASSICAL THEORY: FOURTH-ORDER POTENTIAL**
Yoichi Iwasaki May 1971 52 p refs
(RIFP-124) Avail: NTIS

The perihelion-motion of Mercury depends on the fourth-order potential in quantum field theory; it is a Lamb shift. In spite of the unrenormalizability of the theory, a finite and physically meaningful quantity was extracted, a fourth-order potential, from fourth-order graphs. Renormalization of the Newtonian potential in the fourth-order perturbation is also discussed briefly. The Hamiltonian obtained is the same as the classical one and thus it cannot explain the Dicke-Goldenberg experiment. The fourth-order potential is also calculated in quantum electrodyhamics. Author

**N71-33907+** Department of Scientific and Industrial Research, Wellington (New Zealand).
**NEW ZEALAND SEISMOLOGICAL REPORT, 1965**
1971 705 p refs *Its* Seismological Obs. Bull. E-146
Avail: NTIS

The principal New Zealand earthquakes for 1965 are reported in two categories: local, and distant. All shocks of magnitude of 4.0 and above are included. F.O.S.

**N71-33908+** Department of Scientific and Industrial Research, Wellington, (New Zealand). Geophysics Div.
**NEW ZEALAND SEISMOLOGICAL REPORT: INANGAHUA EARTHQUAKES, 1968**
R. D. Adams, M. A. Lowry, and D. E. Ware 1971 352 p refs *Its* Seismol. Observ. Bull. E-147
Avail: NTIS HC $6.00

The seismological readings for the Inangahua earthquakes of 24 May 1968 are presented along with an analysis of the initial aftershock sequence. A period of 40 days is covered, and 809 shocks of the sequence were observed. Maps showing the epicenters are included. F.O.S.

**N71-33947#** Port Moresby Geophysical Observatory (New Guinea).
**PRELIMINARY EARTHQUAKE PHASES, JUNE – JULY 1971**
1971 6 p
Avail: NTIS

Preliminary earthquake phase seismographic data from Port Moresby geophysical observatory stations are tabulated for June and July 1971 J.M.

**N71-33969** Meteorological Dept., New Delhi (India).
**MAGNETIC, METEOROLOGICAL AND ATMOSPHERIC ELECTRIC OBSERVATIONS MADE AT THE GOVERNMENT OBSERVATORIES BOMBAY, ALIBAG, ANNAMALAINAGAR AND TRIVANDRUM, 1967 (1888-1889 SAKA). PART 2: METEOROLOGICAL AND ATMOSPHERIC ELECTRIC OBSERVATIONS MADE AT COLABA, BOMBAY**
1969 85 p
Avail: Issuing Activity

The results of meteorological and atmospheric electric observations made at Colaba in 1967 are presented. Only a brief summary of the seismic observations is included here as full details are published in Seismological Bulletins of the India Meteorological Department. Author

**N71-33981#** Environmental Research Corp., Las Vegas, Nev.
**OBSERVED SEISMIC DATA, HANDLEY EVENT**
Mar. 1971 99 p refs Revised
(Contract AT(29-2)-1163)
(NVO-1163-216-Rev) Avail: NTIS

The results of the processing of the observed ground motions generated by the Handley event, a contained underground device detonated on Pahute Mesa at the Nevada Test Site are presented. The Handley event yield was approximately the same as the Boxcar and Benham tests. The observed peak resultant vector amplitudes were calculated and plotted versus the slant distance from source to receiver. Regression equations were derived which describe the observed Handley peak resultant vector motions as a function of distance. Pseudo-relative velocity spectra with 5%

damping were derived from the velocity seismic recordings. Data recorded at 73 instrument locations were processed and are included in the form of graphs and maps. Author (NSA)

# 14 INSTRUMENTATION AND PHOTOGRAPHY

**Includes design, installation, and testing of instrumentation systems; gyroscopes; measuring instruments and gages; recorders; transducers; aerial photography; and telescopes and cameras.**

**N71-32815*#** California Univ., Berkeley. Forestry Remote Sensing Lab.
**REMOTE SENSING APPLICATIONS IN FORESTRY: CALIBRATION OF COLOR AERIAL PHOTOGRAPHY**
Robert W. Dana (Pacific Southwest Forest and Range Expt. Sta.) 30 Jun. 1971 18 p refs Prepared in cooperation with Pacific Southwest Forest and Range Expt. Sta.
(NASA Order W-12996)
(NASA-CR-121372) Avail: NTIS CSCL 14E

The need for a calibration program beginning with an in-house capability for sensitometry is explained in terms of a forestry research unit which employs color aerial photography. An inexpensive, good quality sensitometer is described. Considerations of the system spectral balance in the visible and photographic infrared regions are made with special reference to the properties of the attenuating wedge. Modifications in the effective exposure time of the instrument are described. A test of the effects of chemical strength on film calibration was performed for color film processed in Nikor reels. It exemplifies the need for sensitometry with every processing run to insure precise calibration. Author

**N71-32895*#** American Electronic Labs., Inc., Colmar, Pa.
**DESIGN AND DEVELOPMENT OF A FIXED AND A MOBILE DATA COLLECTION PLATFORM**
Jun. 1971 184 p
(Contract NAS5-21184)
(NASA-CR-121374) Avail: NTIS CSCL 14B

The mobile data collection platform for use on constant level balloon vehicles and the fixed data collection platform for use at remote ground locations are described. The platforms send transmit signal to a low-orbit satellite, which relays the data later to a ground station. The mobile and fixed units have essentially the same layouts and components. Three spread boards contain the digital logic sections; the oscillator assembly and buffers are in the center portion, and the RF assembly is at the end. The balloon units employ a highly stable oscillator to enable determination of platform position and/or velocity by use of Doppler techniques. Both units are randomly timed. The sampled data is converted to digital format, encoded, and used to phase shift key an RF transmitter. The digital forma portion employs COS/MOS technology. An oscillator for high-stability, narrowband multipliers for spurious reduction, and stable high-Q amplifiers are used to improve transmission quality. N.E.N.

**N71-32926#** Dayton Univ. Research Inst., Ohio.
**BACK REFLECTION CAMERA ON A BUDGET Technical Report, Mar. 1969 – Mar. 1970**
Mark A. Goldschmidt and Brewster Strope, Jr. (Systems Res. Labs., Inc., Dayton, Ohio) Wright-Patterson AFB, Ohio AFML Mar. 1971 30 p ref
(Contracts F33615-69-C-1330; F33615-69-C-1151)
(AD-724147; AFML-TR-71-26) Avail: NTIS CSCL 14/5

The paper presents in detail the means of converting a powder diffraction camera into a Seemann-Bohlin focusing type back-reflection camera without affecting the primary purpose of the instrument. A Seemann-Bohlin focusing camera, or back-reflection camera as it is called, is one in which the photographic film, the X-ray slit and the powder specimen all lie on the circumference of the same circle. By removing the exit collimator of a standard Siemens 2-radian powder camera and taping a sample across the opening, a back reflection pattern will be obtained. The components are described in detail and specifications are provided. Results on a tungsten standard are illustrated showing the conventional mode opposed to the modified true focusing mode. Problem areas are discussed briefly with emphasis on single-coated film and good optics. Author (GRA)

**N71-32930#** Aerospace Corp., El Segundo, Calif. Lab. Operations.
**ACTIVATING CURRENT SIZE AND SENSITIVITY OF THIN-FILM HEAT GAUGES**
Stephen B. Mason and Robert L. Varwig 15 Mar. 1971 20 p refs
(Contract F04701-70-C-0059)
(AD-724187; TR-0059(6240-10)-4; SAMSO-TR-71-98) Avail: NTIS CSCL 14/2

Requirements for higher output signal from thin-film resistance thermometer heat gauges have been met by the technique of increasing the current that activates the gauge. However, the surface temperature of the gauge is increased by the higher film current. This affects the thermal properties of the surface upon which the thin film is deposited. In the report, tests are described that lead to an empirical relation that determines how much increase in signal may be expected from a platinum thin-film pyrex gauge when the activating film current is increased. Author (GRA)

**N71-32941#** Radio Corp. of America, Princeton, N.J. Astro Electronics Div.
**LONG-LIFE SPACECRAFT TAPE RECORDERS**
C. R. Hume, Robert Miller, and Richard J. Treadwell 1971 8 p refs Presented at the Brit. Interplanet. Soc. Symp. on Appl. Satellites, Southampton, Engl., 14–15 Apr. 1971
Avail: NTIS

The achievements of long-life tape recorders in Tiros, Nimbus, OGO, and other NASA operational spacecraft are reviewed. The environmental testing, life testing, and quality control procedures which supported this achievement are described. Current design approaches are discussed as well as future performance. ESRO

**N71-32947#** Academy of Sciencies (USSR), Moscow. Inst. of Cosmic Research.
**A HIGHLY SENSITIVE MODULATED RADIOMETER FOR 3.5 cm WAVELENGTH**
A. E. Andrievskiy et al 1971 25 p refs In RUSSIAN
Avail: NTIS

A short technical study of the assemblies of the radiometric receiver is presented. The receiver is broken down into the successive functional interaction of the receiver's elements. The radiometer works according to a modulated receiver scheme of direct amplification with a bandwidth from the superhigh frequency range to 1000 megahertz, and has a sensitivity approximately equal to 0.02 K. Constant time storage is equal to one second. Transl. by J.M.C.

**N71-32952#** Royal Aircraft Establishment, Farnborough (England).
**A SATELLITE TIME-OF-DAY CODE GENERATOR**
John A. C. Beattie Dec. 1970 15 p
(RAE-TR-70242) Avail: NTIS

The design of a time-of-day code generator constructed from medium scale integrated circuits mounted on a thick film multilayer printed ceramic substrate is described. This results in the small size and weight required for satellite applications. Power consumption is high but the device should be suitable for space use when low power MSI circuits become available. Author (ESRO)

N71-32966# Istituto Superiore di Sanita, Rome (Italy). Lab. di Fisica.
**PROCEDURE MANUAL FOR THE DEPARTMENT OF ELECTRON MICROSCOPY. 3: STAINING OF SECTIONS: CHEMICAL TREATMENTS OF SECTIONS [ RICETTARIO AD USO DEL REPARTO DI MICROSCOPIA ELECTRONICA. 3: METODI DI CONTRASTO SU SEZIONI; TRATTAMENTI CHIMICI DI PREPARATI]**
2 Apr. 1970 58 p refs In ITALIAN; ENGLISH summary
(ISS-70/9) Avail: NTIS

Chemical, physical and biological procedures employed in the department of electron microscopy are reported. The staining techniques experienced in the department are described, both on ultrathin sections to be observed in the electron microscope, and on thick sections for conventional microscopy (staining methods, fluorescence contrast, phase contrast). Histochemical techniques and subtractive treatments are also described. Author

N71-32967# Istituto Superiore di Sanita, Rome (Italy). Lab. di Fisica.
**INTRODUCTION TO X-RAY DIFFRACTION [INTRODUZIONE ALLA DIFFRAZIONE DEI RAGGI X]**
S. D'Agata 10 Jul. 1969 30 p In ITALIAN; ENGLISH summary
(ISS-69/28) Avail: NTIS

Automatic diffractometry is studied as the most modern technique available to investigate the structures of crystalline substances. The elementary theory of X-ray diffraction is described to provide the necessary background for understanding an automatic diffractometer. Author

N71-32969# Istituto Superiore di Sanita, Rome (Italy). Lab. di Fisica.
**AN EXPERIMENTAL SET-UP FOR MEASUREMENTS OF SOLID STATE SPECTROSCOPY IN THE REGION OF VACUUM ULTRAVIOLET [UN APPARATO SPERIMENTALE PER MISURE DI SPETTROSCOPIA DEI SOLIDI NELLA REGIONE DELL' ULTRAVIOLETTA DA VUOTO]**
M. Grandolfo and C. Ramoni 22 Jul. 1970 22 p refs In ITALIAN; ENGLISH summary
(ISS-70/19) Avail: NTIS

An experimental set-up for measurements of solid state spectroscopy in the region of vacuum ultraviolet is presented. The radiation sources, the monochromator and the optical chamber are described. The emission spectra of Xe2, Kr2 and Ar2 high intensity continuous vacuum ultraviolet sources are included. Author

N71-33024*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
**INTERFEROMETER POLARIMETER Patent Application**
Alain L. Fymat and Krishna D. Abhyankar, inventors (to NASA)
26 p Filed 13 Nov. 1970
(Contract NAS7-100)
(NASA-Case-NPO-11239; US-Patent-Appl-SN-89211) Avail: NTIS CSCL 14B

A system for measuring the intensity and state of polarization of a radiation field as well as obtaining the spectral variations of these quantities with a wide range of spectral resolution, from low to extremely high resolution values, is disclosed. The system employs a beam splitter which serves to divide light from a selected light source into a pair of individual light beams. Each of the light beams is directed through a polarizer. The polarizers are positioned to have preselected planes of polarization with respect to each other and with respect to the plane of polarization of the analyzer. The polarized light beams are applied to a variable optical retarder which serves to selectively modify the relative optical path lengths of the light beams. An optical mixer may be employed to recombine the two light beams. The recombined light beams are projected through an analyzer, such as a linear polarizer, to a sensor or recording device. NASA

N71-33040# Istituto di Fisica dell'Atmosfera, Rome (Italy).
**AN AUTOMATIC COUNTER FOR DIRECT MEASUREMENTS OF RADON CONCENTRATION**
G. Dalu and G. A. Dalu Sep. 1970 23 p refs Presented at the Colloq. on Phys. and Chem. of Aerosols, Fontenay-aux-Roses, France, 24-25 Sep. 1970
(IFA-RDP-32) Avail: NTIS

The counter consists of a brass chamber, into which the air to be examined flows continuously at four litres per minute. Within the chamber there is a ZnS(Ag) scintillator, optically coupled with a photomultiplier. The scintillator is coated with a thin film of gold and, between the chamber and the scintillator, a potential of 100 volts is applied. The positive RaA ions are electrostatically collected on the scintillator, where their subsequent alpha decays and those of RaC' produce scintillations. The construction and calibration of the counter are described. The calibration is achieved by admitting into the chamber known amounts of radon grown from a radium chloride solution. Finally, the methods of sampling and measurement for the evaluation of radon atmospheric concentrations are described. Author (ESRO)

N71-33078# Kansas Univ./Center for Research, Inc., Lawrence. Remote Sensing Lab.
**TEXTURE TONE STUDY WITH APPLICATION TO DIGITIZED IMAGERY Interim Technical Report**
Robert M. Haralick and Joe D. Bissell Dec. 1970 106 p refs
(Contract DAAK02-70-C-0388)
(AD-724117; CRINC-TR-182-1; ETL-CR-70-9) Avail: NTIS CSCL 14/5

The report describes initial research efforts undertaken to determine if texture - a significant but ill-defined property of virtually all substances can be used in a practicable automated image interpretation technique. The authors attempt to establish a basis for measures which define the important qualities of texture by first considering discrete tonal features in an image as constituents of areas of homogeneity or lack of homogeneity (unhomogeneity). The concept of homogeneity is intended here to signify the existence of groups of similar neighboring resolution cells, which have been judged similar by some prespecified criterion. Homogeneity displays or plots are constructed by linking or connecting the similar neighboring resolution cells and ignoring all others. Unhomogeneity infers a lack of similarity of neighboring resolution cells; and an unhomogeneity plot then, is a display of linked, dissimilar neighboring resolution cells. Digital computer algorithms were written to determine the extent of homogeneity for each resolution cell in a picture, and a group of ten (5 homogeneity and 5 unhomogeneity) on-line plots were made for each of the 36 images. Author (GRA)

N71-33080# Army Test and Evaluation Command, Aberdeen Proving Ground, Md.
**PHOTOGRAPHIC COVERAGE Final Report**
3 May 1971 9 p
(AD-724081; MTP-7-3-519) Avail: NTIS CSCL 14/5

Guidance is furnished for the integration of photographic methods and techniques into the service test of aircraft and aircraft related weapons and ancillary equipment. Author (GRA)

**N71-33094#** White Sands Missile Range, N.Mex. Missile Electronic Warfare Technical Area.
**THE DUAL 37 GHz/94 GHz RADIOMETER**
Robert Lee and Richard Murray Ft. Monmouth, N.J. Mar. 1971 25 p
(AD-724111; ECOM-5357) Avail: NTIS CSCL 14/2

The report contains a description of the design and development of a dual-frequency radiometer. Particular emphasis is placed on its versatility and the calibration technique used. A reference antenna with a spatially offset beam provides a reference for background discrimination if a tracking mode of operation is desired. Radiometer sensitivity at an integration time of one second is 4.4K at 37 GHz and 8.2K at 94 GHz. Author (GRA)

**N71-33106*#** Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
**TEMPERATURE CONTROL SYSTEM WITH A PULSE WIDTH MODULATED BRIDGE Patent Application**
Richard C. Heyser, inventor (to NASA) 14 p Filed 24 Dec. 1970 Sponsored by NASA
(NASA-Case-NPO-11304; US-Patent-Appl-SN-101214) Avail: NTIS CSCL 14B

A temperature control system is disclosed which includes a modified wheatstone bridge with a resistive-capacitive (RC) circuit in one leg of the bridge. The RC circuit includes a resistor which provides an effective resistance as a function of its absolute resistance and the on-time to off-time ratio of pulses supplied to a switch. A sawtooth voltage is produced across the RC circuit, the voltage being compared with the voltage across a temperature sensor, with heat being applied during each pulse period portion when the sawtooth voltage exceeds the voltage across the temperature sensor. NASA

**N71-33115#** Academy of SSciences (USSR), Moscow. Inst. for Space Research.
**ON SPACE VACUUM SIMULATION IN LABORATORY INVESTIGATION OF BALL-BEARINGS DESIGNED FOR WORK IN OUTER SPACE**
M. D. Nusinov 1971 16 p refs
(D-61) Avail: NTIS

In order to understand the role of friction in ball bearings under space vacuum conditions, the Monte Carlo method is applied to the molecular trajectories in the clearances in the friction zone, and the phenomena in this zone are analyzed theoretically. Preliminary wear tests under vacuum conditions are described. ESRO

**N71-33117#** Royal Aircraft Establishment, Farnborough (England).
**ON TECHNIC SENSOR TECHNOLOGY**
H. K. P. Neubert Jan. 1971 35 p refs Presented at the Symp. on Teaching of Instrumentation in Eng. Courses of the Inst. of Mech. Engr., London, 9–10 Jun. 1971
(RAE-TM-IR-117) Avail: NTIS

After briefly considering presuppositions, aims, and methods of teaching sensor technology to both users and designers of sensors, the generalized performance characteristics of static and dynamic sensors as components of instrumentation systems, are discussed, concluding with a unified theory of bilateral transducers. Sensor types are then classified according to physical effects and, alternatively, according to input quantities. From the latter scheme pressure sensors are chosen to illustrate scope and variety of relevant transducer types, calibration techniques, and environmental effects. Author (ESRO)

**N71-33130#** Osservatorio Astrofisico di Arcetri, Florence (Italy).
**INTERFEROMETRIC MEASUREMENTS OF SOLAR RADIATION AT 3 cm lambda Internal Report No. 1 [MISURE INTERFEROMETRICHE DEL RADIO SOLE A 3 cm lambda Rapporto Interno No. 1]**
M. Felli, P. Pampaloni, and G. Tofani Florence Univ. 1970 26 p refs In ITALIAN; ENGLISH summary *Its* Osservazioni e Mem Fascicolo 96
Avail: NTIS

The interferometric techniques for the study of the three fundamental components of the sun radio emission at 3 cm lambda are examined. The theory of the solar interferometers is shown together with an analysis of the most important applications in the world. A program has been established in order to realize an interferometric system at 3 cm lambda at the Arcetri Observatory. Author (ESRO)

**N71-33175#** Office National d'Etudes et de Recherches Aerospatiales, Paris (France).
**AN INFRARED TRANSDUCER FOR SPACE APPLICATIONS [TRANSDUCTEUR INFRAROUGE POUR APPLICATIONS SPATIALES]**
Michel Chatanier and Georges Gauffre 1971 8 p refs Presented at the meeting of the D.G.L.R. on Applications of Satellites, Berlin, 24-26 May 1971
(TP-963) Avail: NTIS

Infrared detectors used in space have so far been restricted to two types, namely quantic receivers in the near infrared, and bolometers for applications over a wider spectral range. Other thermal detectors such as pyroelectric or pneumatic types are now available; their laboratory test shows performances close to uncooled bolometer ones. Their application to space ends does not reveal insuperable difficulties any longer. Author

**N71-33202*#** Geological Survey, Washington, D.C.
**TEST OF DATA COMPILATION PROCEDURES FOR THE FRAUNHOFFER LINE DISCRIMINATOR**
George E. Stoertz 1969 49 p refs
(NASA Order T-80485C)
(NASA-CR-121427; Rept-175) Avail: NTIS CSCL 14B

Procedures for relating strip chart records to fluorescent dye concentrations during operational use of the FLD over open water were tested. It appeared practicable to correct for the pertinent environmental and instrumental variables. FLD extimates of dye concentration required either frequent water sampling from the air, or frequent in-flight monitoring of standard targets. Procedures were established for laboratory analysis of water samples and for compilation of the data. Compilation was tedious and will require use of a computer if the present FLD is extensively used for quantitative work. An improved model having only one photomultiplier should greatly reduce the variation in sensitivity and facilitate realtime data reduction. Use of any foreseeable model of FLD over relatively clear coastal waters or over ocean waters will require some sampling with depth. Author

**N71-33205*#** Rice Univ., Houston, Tex. Dept. of Space Science.
**FLYING INFRARED TELESCOPE Final Report, 1 Apr. 1967–31 May 1971**
F. J. Low 1971 62 p refs
(Grant NGR-44-006-065)
(NASA-CR-121414) Avail: NTIS CSCL 14B

A telescope was developed which makes possible routine flux measurements of astronomical objects whose spectral energy peak occurs at wavelengths longer than 25 microns. The 12 inch (30 cm) gyrostabilized instrument is operated by an observer flying on a jet aircraft in the lower stratosphere. The historical development, engineering aspects, and the observational record of the flying infrared telescope are discussed. Author

N71-33208# National Aerospace Lab., Tokyo (Japan).
**AUTOMATIC TRACKING TYPE FLOW DIRECTION AND VELOCITY METER**
Nagakatsu Kawahata and Teruomi Nakaya Mar. 1970 12 p refs In JAPANESE; ENGLISH summary
(NAL-TM-172) Avail: NTIS

An automatic flow meter which can be used for the measurement of the velocity and the direction of wind flow in a localized flow field has been developed. The principle for determining the flow speed by this device is that the pressure difference between the central hole and any one of the others is proportional to the dynamic pressure of the flow, and that its proportional constant is unique for the truncated pyramid type head when it is aligned with the flow direction. The instrument was tested in a wind tunnel over a wide range of flow speeds and was found to be efficient. The accuracy in the directional finding of this instrument is better than 0.5 degrees at a flow velocity higher than 8 m/sec. The error of the measurement of the flow velocity is about + or - 1.5 m/sec and it is clearly caused by noise in the electric circuit. Because of its smallness and the simplicity of its mechanism, the instrument is expected to be widely applied in the field of flow measurements. A measured flow field behind a wing immersed in the propeller slipstream is presented as an example of the application of this instrument. The frequency response characteristics measured in a fluctuating flow are also shown. Author

N71-33210# National Oceanic and Atmospheric Administration, Miami, Fla. Atlantic Oceanographic and Meteorological Labs.
**SOME TESTS ON THE RADIOSONDE HUMIDITY ERROR**
Feodor Ostapoff, Willard W. Shinners, and Ernst Augstein (Hamburg Univ., West Germany) Dec. 1970 53 p refs
(NOAA-TR-ERL-194-AOML-4) Avail: SOD $0.55

Humidity data obtained from carbon hygristors flown in radiosondes used by U.S. meteorological services in low latitudes appear to have significant errors due to solar heating. Specifically modified radiosondes to block solar radiation were flown simultaneously with unmodified radiosondes to determine the magnitude of the error. Additional tests were made in a vertical wind tunnel to check ventilation rates of the hygristor, and a temperature/humidity chamber was used to verify the temperature dependence of the sensor. A correction curve for application to ATEX daytime data was developed and compared with a similar curve based on comparison flights between the German radiosonde M60 and the U. S. 403 MHz radiosonde. These tests were made in the Equatorial Atlantic in March 1969. Independent tests of the proposed corrections were applied to data obtained during July and August 1970 in the sub-tropical Atlantic with good results. Author

N71-33241# National Aerospace Lab., Tokyo (Japan).
**STUDY ON THE ANALOG TORQUE REBALANCE FLOATED PENDULUM TYPE ACCELEROMETERS FOR GUIDANCE AND CONTROL APPLICATIONS**
Masao Otsuki, Takao Suzuki, and Shigeru Enkyo 1971 31 p refs In JAPANESE; ENGLISH summary
(NAL-TR-230) Avail: NTIS

Null balance, floated pendulum accelerometers combined with analog feedback servoamplifiers were studied for rocket vehicle guidance and control applications. An accelerometer with a permanent magnet torquer and a signal generator excited at much higher frequency than that of the prototype was developed. The design and experimental results of the new accelerometer are reported and compared with those of the prototype employing a microsyn torquer. Author

N71-33321*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
**METHOD AND APPARATUS FOR HIGH RESOLUTION SPECTRAL ANALYSIS Patent Application**
Willard F. Gillmore, Jr., inventor (to NASA) 30 p Filed 13 Aug. 1970
(Contract NAS7-100)
(NASA-Case-NPO-10748; US-Patent-Appl-SN-63383) Avail: NTIS CSCL 14B

A method and apparatus for high resolution power spectral analysis employing a digital computer is provided without stringent stability requirements on the sampling rate. This is accomplished by using a pair of balanced mixers to combine me signal, directly and in quadrature with a second signal, and alternately sampling the ouptuts of the mixers through an alanog to digital converter. The computer then carries out computations of a convolution spectrum from two autocorrelation and two cross correlation functions. These functions can be computed from the two sequences of samples with compensation for variations in gain of the signal channels by normalizing correlation functions. Known deviation from −90 deg in the quadrature mixing of signals by using phi in place of −90 deg in the analysis and dividing the sum of the cross correlation functions by −sin phi. NASA

N71-33322*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
**THIN FILM LIGHT DETECTOR Patent Application**
Joseph Maserjian and George W. Lewicki, inventors (to NASA) 29 p Filed 10 Nov. 1970
(Contract NAS7-100)
(NASA-Case-NOP-11432; US-Patent-Appl-SN-88435) Avail: NTIS CSCL 14B

A photovoltaic cell structure having a trapezoidal barrier is described. An aluminum, magnesium, or tantalium base is vapor deposited on a quartz substrate to a thickness of about 40 to 60 A. An oxide or nitride film of the base metal is produced as an insulator by reaction in a glow discharge plasma to a thickness of less than 100 A (typically 30 to 60 A), and a metal, preferably gold counter-electrode, is vapor deposited on the insulating layer. A bias generator of high impedance is employed to set and shift or modulate the spectral response of the structure. NASA

N71-33397*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
**A STUDY OF THE FEASIBILITY OF APPLYING CAPACITIVE DISPLACEMENT MEASURING TECHNIQUES TO OPEN MESH GRID STRUCTURES**
Richard de Loach Washington Sep. 1971 42 p refs
(NASA-TN-D-6341; L-7465) Avail: NTIS CSCL 14B

The feasibility of employing a capacitive probe in displacement measurements of structures with low surface areas, particularly open-mesh grid structures is evaluated. The field of a square-mesh grid-plate capacitor is solved. A variational technique is used to determine the capacitance of the grid-plate capacitor in terms of easily measured geometric parameters. The derived theoretical capacitance formula predicts grid-plate capacitance values which are orders of magnitude larger than preliminary intuitive estimations. The theory is supported with experimental data. A laboratory prototype system is described which is capable of resolving displacements on the order of 0.01 mm in a 15 sq cm open-mesh grid with the probe as far away from the net as 25 cm. Author

N71-33418# National Research Council of Canada, Ottawa (Ontario).
**ANALYSIS OF LINE PROFILES. 2: ANALYSIS OF INTENSITY DISTRIBUTION PATTERNS FROM A FABRY-PEROT INTERFEROMETER, TABLE OF DISTRIBUTION FUNCTIONS [ANALYSE VON LINIENPROFILEN. 2: AUSWERTUNG REGISTRIERTER INTENSITAETSVERTEILUNGEN EINES FABRY-PEROT-INTERFEROMETERS, TABELLE DER VERTEILUNGSFUNKTIONEN]**

F. Bayer-Helms 1971 35 p refs Transl. into ENGLISH from Z. Angew. Physik (West Germany), v. 15, no. 5, 1963 p 416–429
(NRC-TT-1466) Avail: NTIS

A table of distribution functions is presented which provide the basis for analysis of the intensity distribution patterns. The description of the analysis includes a method of eliminating the effect of faults in the interference equipment. For the spectral lines investigated, the asymmetry of the distribution and line profiles are characterized in a simple manner by the inclination of a symmetrical curve. Author

**N71-33432*#** Space Disturbances Lab., Boulder, Colo.
**HIGH ALTITUDE NUCLEAR DETECTION STUDIES, VOLUME 2: RESULTS AND RECOMMENDATIONS Final Report**
A. G. Jean, C. E. Hornback, R. H. Doherty, L. D. Lewis, and G. M. Lerfald Nov. 1970 221 p refs
(ARPA Order 183; ARPA Order 521; ARPA Order 932)
(NOAA-TR-ERL-188-SDL-18-2) Avail: SOD $1.25

The results produced by the High Altitude Nuclear Detection Studies (HANDS) program are of three general types: (1) developments in automatic processing and handling of geophysical data collected from a large number of sensors, and (2) findings bearing on the capabilities of nuclear detection systems, and (3) conclusions of rather broad scientific interest. Descriptions and/or examples of some of the more important of these results are given. An appraisal is made of the HANDS program, including some shortcomings, and some recommendations for future similar systems are given. Author

**N71-33450#** Office National d'Etudes et de Recherches Aerospatiales, Paris (France).
**TEMPERATURE MEASUREMENT BY ELECTRON BEAM PROBE [MESURE DE TEMPERATURES PAR LA SONDE A FAISCEAU D'ELECTRONS]**
Serge Lewy 1971 7 p refs In FRENCH; ENGLISH summary Presented at the Colloq. de la Soc. Francaise de Phys., Evian, 25–29 May 1971
(TP-960) Avail: NTIS

Rarefied gas probing by electron beam permits the measurement of molecular distributions at their various vibrational and rotational levels. Simplifications to generally used computation models are suggested; they do not reduce the precision of the results. Author

**N71-33476#** Pennsylvania State Univ., University Park. Dept. of Physics.
**LIGHT SCATTERING AND SPECTROSCOPY Technical Report, 1 Mar. 1970–28 Feb. 1971**
D. H. Rank Feb. 1971 73 p refs
(Contract N00014-67-A-0385-0012)
(AD-720371) Avail: NTIS

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**N71-33477*#** Pennsylvania State Univ., University Park. Dept. of Physics.
**MEASUREMENT OF HYPERSONIC SOUND SPEEDS IN METHANE AT MODERATE PRESSURES**
M. J. Cardamone, T. T. Saito, D. P. R. Eastman, and D. H. Rank *In its* Light Scattering and Spectry. Feb. 1971 7 p refs Supported by NASA, ONR, and NSF (See N71-33476 20-14)
(NASA-CR-121377) Avail: NTIS CSCL 14B

Results of spontaneous Brillouin scattering experiments to measure hypersonic sound speeds in methane at moderate pressures are reported. The purpose was to test the possibility that a phenomenon intrinsic to stimulated Brillouin scattering yields a sound speed less than actual speeds and accounts for recently observed discrepancies between measured speeds and reported ultrasonic speeds measured at lower frequencies. Using a cw laser frequency shift measurements of the spontaneous Brillouin scattered light from methane at various pressures were obtained to an accuracy of 1%. Resulting hypersonic sound spped measured in the gas were lower than results of ultrasonic measurements. Similarly, hypersonic sound speeds measured by means of the stimulated Brillouin effect were less than the measured ultrasonic speeds. Two possible explanations of this discrepancy are suggested: (1) there is a negative dispersion of the sound speed in methane; or (2) the frequency shift to the peak of the Brillouin lines does not correspond to the frequency of the sound waves. Present theories including either of these possibilities appear inadequate to describe the large differences between ultrasonic and light scattering data. A.C.R.

**N71-33478#** Pennsylvania State Univ., University Park. Dept. of Physics.
**BROADENING AND SHIFTING OF HF LINES DUE TO NOBLE GASES**
T. A. Wiggins, N. C. Griffen (M.S. Thesis), E. M. Arlin (M.S. Thesis), and D. L. Kerstetter (M.S. Thesis) *In its* Light Scattering and Spectry. Feb. 1971 13 p refs Submitted for publication (See N71-33476 20-14)
Avail: NTIS

Line widths in the 1-0 and 2-0 bands of hydrogen fluoride due to a standard atmosphere of argon, krypton and xenon were measured. Results in the 1-0 band are similar to those seen in hydrogen chloride. In the 2-0 band the widths increase at high J values for the heavier perturbers and show a significant decrease with increasing temperature. Results of line shift measurements in the 2-0 band corroborate previous measurements and indicate that the shifts are not proportional to the vibrational quantum number of the upper state or to the polarizability of the perturbing gas. Author

**N71-33479#** Pennsylvania State Univ., University Park. Dept. of Physics.
**DIFFUSION OF NONLINEARLY SCATTERED LIGHT BY ETCHED GLASS**
T. A. Wiggins, T. T. Saito, L. M. Peterson, and D. H. Rank *In its* Light Scattering and Spectry. Feb. 1971 10 p refs Submitted for publication Supported in part by NSF (See N71-33476 20-14)
Avail: NTIS

Diffusion of nonlinearly scattered light by etched glass in experiments using Fabry-Perot interferometers in conjunction with a laser light source was studied to determine the cause of granularity in the rings associated with stimulated light scattering. A second purpose was to investigate the influence of the etched glass surface on the characteristics of the transmitted light. It was found that when ground or etched glass is used to diffuse the light for producing the interferogram, the observed granularity is caused by an interference effect and may be helpful in identifying the rings associated with a stimulated scattering phenomenon. The granularity can be reduced by using a Galilean telescope in front of the ground glass to enlarge the stimulated scattered beam. In addition, it was found that size, size distribution, and the number of scattering centers have little effect on the granularity. A.C.R.

**N71-33480#** Pennsylvania State Univ., University Park. Dept. of Physics.

**OPTICAL TOLERANCES AND ELECTRIC FIELDS IN RESONANT REFLECTORS**

T. A. Wiggins, Catherine E. Procik, and J. Pliva *In its* Light Scattering and Spectry. Feb. 1971 24 p refs Submitted for publication Supported in part by NSF (See N71-33476 20-14)
Avail: NTIS

The importance of flatness, parallelism, and equality in thickness of the elements and spacers of a resonant reflector is discussed. Using the matrix method, the reflectivity versus wavelength is computed for several types of resonators, and the thicknesses of whose elements were subject to variations. For a two-element device, the exact mechanical thickness of the spacer is not important, but the equality of thickness of the dielectric elements is critical. For a three or four element device, the exact thickness of the center element is least important to reflectivity, but the reflectivity decreases if the total error in orders on either side of the center approaches 1/2. The results indicate it is extremely difficult to produce a practical device of this complexity. Pressure and temperature scanning is discussed. Experimental results were obtained for two-element devices showing the importance in equality of thickness and the sensitivity to non-parallelism of the spacer. The relative electric field strengths within the reflector were mapped to investigate susceptibility to radiation damage. The amplitude of the field and the position in the resonator where damage would first occur depends upon the reflectivity at the wavelength used. Author

**N71-33482#** Pennsylvania State Univ., University Park. Dept. of Physics.

**VIBRATIONAL RELAXATION IN CARBON TETRACHLORIDE**

M. J. Cardamone and D. P. Eastman *In its* Light Scattering and Spectry.Feb. 1971 6 p refs Supported in part by NSF (See N71-33476 20-14)
Avail: NTIS

Vibrational relaxation in carbon tetrachloride was investigated. The purpose was to test other results obtained by stimulated Brillouin scattering, which indicated that relaxation processes in this material can be described by a single relaxation time only at the melting point, boiling point, and room temperature. It is contended that these findings are questionable due to possible error in the values used for hypersonic speed. Using different speed values, analyses were performed which showed faborable agreement above 290 K, but below this temperature the earlier model becomes increasingly insufficient. A.C.R.

**N71-33483#** Pennsylvania State Univ., University Park. Dept. of Physics.

**POLARIZATION OF LIGHT SCATTERED FROM OPTICAL GLASS**

D. H. Rank and Paul Yoder, Jr. *In its* Light Scattering and Spectry. Feb. 1971 8 p refs Submitted for publication (See N71-33476 20-14)
Avail: NTIS

Careful measurements are reported on the depolarization of light scattered by some common very perfect specimens of optical glass. Measurements of rho sub u, rho sub v and rho sub h are made with sufficient precision so that the reciprocity relationship can be checked quantitatively. The results indicate that for all the glasses studied, rho sub h is less than unity, thus indicating that a Krishnan effect occurs in these optical glasses. The fact that rho sub h is less than unity probably indicates that a type of molecular clustering occurs in these optical glasses. Author

**N71-33520#** Los Alamos Scientific Lab., N.Mex.

**IMPROVED LIGHT SCATTERING PHOTOMETER FOR AIR FILTERATION SYSTEM STUDIES**

R. D. Hiebert, R. G. Stafford, and L. L. Pollat Feb. 1971 7 p refs
(Contract W-7405-eng-36)
(LA-4627) Avail: NTIS

A light scattering photometer was designed which offers a high degree of sensitivity and stability with negligible electrical noise. Sensitivity and linearity were provided which allow detection of 0.3 micrometers particles in concentrations as low as $2.5 \times 10$ to the 7th power mug/cc (15 particles/cc). A solenoid valve was designed and incorporated into an automatic pushbutton control sampling system. This valve has eliminated impaction problems and is leak proof at pressures in excess of those usually encountered in the normal operation of the photometer. Author

**N71-33590*#** Translation Consultants, Ltd., Arlington, Va.

**APPLICATION OF COSMOGRAPHIC PERSPECTIVES IN THE INTERPRETATION OF PHOTOGRAPHS TAKEN IN SPACE [PRIMENENIYE KOSMOGRAFICHESKIKH PERSPEKTIV PRI DESHIFRIROVANII FOTOGRAFIY, SDELANNYKH V KOSMOSE]**

V. Dumitresku Washington NASA Sep. 1971 7 p refs Transl. into ENGLISH from Geodeziya i Kartografiya (USSR), Oct. 1966 p 59–62
(Contract NASw-2038)
(NASA-TT-F-13928) Avail: NTIS CSCL 14E

The development of another way of drawing azimuthal perspective projections of the earth, the so-called cosmographic projections is discussed. The main advantage is that these cosmographic projections present the globe as seen from a finite distance and can thus replace orthographic projections which should only be used for the reproduction of heavenly bodies obtained by means of a telescope from quasi-infinity. Author

**N71-33593*#** National Aeronautics and Space Administration, Washington, D.C.

**ELECTRONIC TEST INSTRUMENTATION AND TECHNIQUES: A COMPILATION**

1971 36 p
(NASA-SP-5907(02)) Avail: NTIS CSCL 14B

This compilation deals with the broad and diverse technology of electronic test instrumentation and techniques that have been developed as NASA has progressed in fulfilling its role of exploring the aerospace environment. The material has been selected and divided into categories which represent, not the original intent of the instrumentation, but the transfer of the test capability to commercial and industrial applications. The six major divisions include: (1) electronic test instrumentation that generally can be constructed by the skillful hobbyist or electronics technician; (2) instrumentation test procedures for measuring the properties of simple devices and systems; (3) instrumentation that can be applied in the expanding field of electronics test instrumentation in medical applications; (4)

instrumentation that can be used in solving the chronic problems which confront us in controlling and defining the pollution of the earth's ecological system; (5) sophisticated and complex electronics for the test of large systems, such as digital computers and communications networks; and finally; (6) the most important function of test instrumentation-to assure the quality and reliability of electronic components and systems. Author

**N71-33604#** Comision Nacional De Investigaciones Especiales, Buenos Aires (Argentina).
**RESULTS OF THE STUDY TO DEVELOP SENSORS FOR MEASURING PROTONS AND ELECTRONS OF PRECIPITATION, AND X-RAYS IN THE SOUTH AMERICAN ANOMALIES BY ROCKET INSTRUMENTS [REALIZACION DEL ESTUDIO Y DESARROLLO DE SENSORES PARA LA MEDICION DE PROTONES Y ELECTRONES DE PRECIPITATION Y RAYOS X EN LA ANOMALIA SUDAMERICANA MEDIANTE INSTRUMENTAL TRANSPORTADO EN COHETES]**
J. R. Manzano and O. R. Santochi 1969 31 p refs In SPANISH *Its* Informe de Contrato No. 7
Avail: NTIS

The design and construction X-ray spectrometers for the sounding rockets Arcas and Orion 2 are described for use in measuring photons in the upper atmosphere. Descriptions of the mechanical structure, circuitry, and telemetry are included. Transl. by F.O.S.

**N71-33605#** Comision Nacional de Investigaciones Espaciales, Buenos Aires (Argentina).
**DIRECTIONAL SOLID STATE DETECTOR FOR MEASURING PROTONS BETWEEN 1 MeV AND 8 MeV FOR USE IN ROCKET ENGINES [DETECTOR DE ESTADO SOLIDO DIRECCIONAL PARA MEDICION DE PROTONES DE ENERGIAS COMPRENDIDAS ENTRE 1 MeV Y 8 MeV, A SER UBICADO EN LA CARGA UTIL DE UN CO HETE DRAGON]**
J. R. Manzano and O. R. Santochi 1969 23 p refs In SPANISH *Its* Informe de Contrato No. 8
Avail: NTIS

The preliminary work in the design and construction of the solid state proton detector is reported. The semiconductor detector is compared to an ionization chamber, and descriptions of the mechanical aspects, and electronic circuits are included. Author

**N71-33748** British Broadcasting Corp., Kingswood (England). Research Dept.
**COLOUR FILM TELERECORDING USING A SHADOW-MASK DISPLAY TUBE**
J. D. Lunn 1971 8 p refs
(BBC-1971/23; PH-77) Avail: BBC, Kingswood Warren, Tadworth, Surrey, England

The development of shadow-mask tubes with increased luminance has justified an investigation into the feasibility of using such a display in colour-film telerecording equipment. This would represent a considerably simplification over an earlier colour telerecording proposal in which a system of dichroic mirrors superimposed the displays from three separate cathode ray tubes, each carrying a single display primary. Owing to the nature of the shadow-mask display, optical filters cannot be used to modify the spectral characteristics of the individual phosphors in order to minimise the degree of 'cross-talk' occurring within the film. This problem is discussed, together with the limitations on the maximum luminance of the display. It is concluded that satisfactory colorimetric results can be obtained with the phosphors and film considered; an adequate exposure for colour negative film would be provided by f/1·4 camera lens. Author

**N71-33749#** Physics Lab. RVO-TNO, The Hague (Netherlands).
**A 1200 BAUD FSK DEMODULATOR (CCITT STANDARD) REALISED IN DIGITAL INTEGRATED CIRCUITS [EEN 1200 BAUD FSK-DEMODULATOR VOLGENS CCITT NORMEN, OPGEBOUND UIT DIGITALE GEINTEGREERDE SCHAKELINGEN]**
H. G. M. Bennis and R. A. van Zurk Mar. 1971 19 p refs In DUTCH; ENGLISH summary
(Ph-L-1971-12; TDCK-57801) Avail: NTIS

A 1200 band frequency shift keying demodulator for the frequencies 900 and 2100 Hz (CCITT standard), using a delay line discriminator is described. Except for the line transformer and the zero-crossings detector only digital integrated circuits are used. Author

**N71-33768*#** Temple Univ., Philadelphia, Pa.
**OGO-3 DUST PARTICLE EXPERIMENT: DATA REDUCTION AND ANALYSIS Final Report**
J. Lloyd Bohn [1971] 82 p refs
(Contract NAS5-9352)
(NASA-CR-121477) Avail: NTIS CSCL 14B

The OGO 3 spacecraft contained an experiment to measure various physical parameters of picogram size dust particles in cis-lunar and near earth space. Information concerning the scientific objectives of the experiment, the basic sensors and detector array, the sensor calibration, electronic instrumentation, and experiment data are presented. Author

**N71-33848#** Institut fuer Angewandte Geodaesie, Frankfurt am Main (West Germany).
**THE MEASUREMENTS BY GEODIMETER-2A FROM THE INSTITUTE FOR APPLIED GEODESY FOR THE WEST GERMAN PART OF THE EUROPEAN CALIBRATION LINE TROMSO-CATANIA [DIE GEODIMETER-2A-MESSUNGEN DES INSTITUTS FUER ANGEWANDTE GEODAESIE IM WESTDEUTSCHEN ANTEIL DER EUROPAEISCHEN EICHLINIE TROMSO CATANIA]**
Hermann Dirk 1970 34 p refs In GERMAN; ENGLISH summary *Its* Reihe B: Angewandte Geodaesie No. 178
(Rept-126) Avail: NTIS

Electronic distance measurements with the Geodimeter 2A in the West-German part of the European calibration line for satellite triangulations Tromso – Catania are reported. In addition to the 15 first-order lines measured between 1962 and 1968, which are part of the triangulation chain constituting this traverse, another 10 lines were measured in 1967 and 1968. The combined results of all measurements for these 25 lines are given in this report. Author

**N71-33860#** Physics Lab., RVO-TNO, the Hague (Netherlands).
**A 1200 BAND FSK MODULATOR (CCITT STANDARD) REALISED IN DIGITAL INTEGRATED CIRCUITS [EEN 1200 BAND FSK-MODULATOR VOLGENS CCITT NORMEN, OPGEBOUND UIT DIGITALE GEINTEGREERDE SCHAKELINGEN]**
H. G. M. Bennis and R. A. van Zurk Mar. 1971 13 p In DUTCH; ENGLISH summary
(Ph-L-1971-11; TDCK-57800) Avail: NTIS

A description is given of a 1200 FSK modulator using, according to the CCITT standard, the frequencies of 1300 and 2100 Hz. Digital integrated circuits are used throughout, except for the line driver stage. Author

**N71-33906#** National Inst. for Telecommunications Research, Hartebeesthoek (South Africa). Deep Space Instrumentation Facility.
**MARINER 9 AND 1(9) INITIAL MISSION SUMMARY REPORT UP TO 18 JUNE 1971**

H. M. Bryant 30 Jun. 1971 21 p
(DSIF-51/OP-S) Avail: NTIS

The launch and failure of Mariner H and the launch and midcourse maneuver of Mariner 9 are summarized. All passes up to 18 June 1971 are included. Premission testing and training, operations, communications, and equipment operation are discussed. N.E.N.

**N71-33913#** Idaho Nuclear Corp., Idaho Falls.
**ULTRASONIC LEVEL MONITOR**
T. J. Boland and J. B. Thompson Mar. 1971 66 p refs
(Contract AT(10-1)-1230)
(IN-1452) Avail: NTIS

An ultrasonic level monitor has been developed to monitor the level of radioactive solids waste. The same basic instrument can also be used to monitor the instantaneous level of the liquid in pulsed extraction columns. A single transducer mounted at or near the top of a containment vessel transmits an ultrasonic signal burst through air to a liquid or solids surface. The large mismatch of acoustic impedance existing at air-liquid or air-solid interfaces results in essentially 100% reflection of the incident ultrasonic wave. The time required for the pulse to make the round trip from the transducer to the reflective surface is a measure of the distance travelled. The design, operation, and performance of the level monitor are presented. NSA

# 15 MACHINE ELEMENTS AND PROCESSES

**Includes bearings, seals, pumps, and other mechanical equipment; lubrication, friction, and wear; manufacturing processes and quality control, and reliability; drafting; and materials fabrication, handling, and inspection.**

**N71-32819#** Technische Hogeschool, Eindhoven (Netherlands). Afdeling der Elektrotechniek.
**OZONE FORMATION BY MEANS OF ELECTRICAL DISCHARGES [OZONBILDUNG MITTELS ELEKTRISCHER ENTLADUNGEN]**
Leonard Marie Louis Francois Hosselet (Ph.D. Thesis) Mar. 1971 176 p refs In DUTCH; ENGLISH summary
(TH-71-E-19) Avail: NTIS

Ozone formation by electric discharges, and associated circuitry, is investigated in order to obtain an economic ozone production. Theoretically it should be possible to obtain an efficiency of 1220 g ozone/kWh. The influence of a higher operational frequency is dealt with, and possible application to water purification is mentioned. ESRO

**N71-32849#** Bureau of Mines, Washington, D.C.
**A NEW HIGH-TEMPERATURE SOFT SOLDER SYSTEM**
Alfred E. Schwaneke, Wilbert L. Falke, and Orrin K. Crosser Dec. 1970 23 p refs
(PB-196675; TPR-29) Avail: NTIS CSCL 13H

A new high-temperature soft soldering system was developed for use on copper, copper alloys, and low-carbon steel; the method is applicable to automobile radiators and home appliances. The system uses a unique sacrificial metal coating method to promote spontaneous wetting and spreading of zinc and zinc alloy solders on metallic substrates. The 100,000 to 1,000,000 cm thick, electroplated or sputtered, sacrificial nickel coating is absorbed by the molten filler alloy during soldering and produces a direct solder-substrate metallic bond. Preliminary measurements on butt joints with copper members give tensile strengths up to 22,000 psi at room temperature using 95 Zn-5 Al alloy as solder. Author (US GRDR)

**N71-32910#** Joint Publications Research Service, Washington, D.C.
**DEVELOPMENTS IN ROBOT DESIGN**
3 Aug. 1971 19 p Transl. into ENGLISH from Znaniye-Sila (Moscow), no. 4, Apr. 1971 21 p.
(JPRS-53742) Avail: NTIS

CONTENTS:
1. WORK ON ROBOTS AND AUTOMATION K. Levitin 4 p (See N71-32911 20-15)
2. STRIDING INFORMATION DEVICE V. Brel 2 p (See N71-32912 20-15)
3. STRIDING APPARATUS A. Kobrinskiy 12 p (See N71-32913 20-15)

**N71-32911#** Joint Publications Research Service, Washington, D.C.
**WORK ON ROBOTS AND AUTOMATION**
K. Levitin *In its* Develop. in Robot Design 3 Aug. 1971 4 p (See N71-32910 20-15)
Avail: NTIS

A definition of robot engineering is outlined. Requirements are formulated to be imposed on robots capable of performing anthropomorphic movements and fitted with sense organs, an artificial intellect, and independence. Other topics covered at the conference on the basic problems of machines and mechanisms are briefly mentioned. J.A.M.

**N71-32912#** Joint Publications Research Service, Washington, D.C.
**STRIDING INFORMATION DEVICE**
V. Brel *In its* Develop. in Robot Design 3 Aug. 1971 2 p (See N71-32910 20-15)
Avail: NTIS

A striding information consisting of a long rod, two supports, and an information block is briefly described. The information block contains a wide range of instruments such as samplers, television cameras, and various other equipment for data acquisition and processing. J.A.M.

**N71-32913#** Joint Publications Research Service, Washington, D.C.
**STRIDING APPARATUS**
A. Kobrinskiy *In its* Develop. in Robot Design 3 Aug. 1971 12 p (See N71-32910 20-15)
Avail: NTIS

An analogy is drawn between the motor functions of man's legs and the development of mechanical legs for striding vehicles. The research being conducted in the Soviet Union on developing such vehicles is outlined, and their application to planetary surface transportation is discussed. M.G.J.

**N71-32923*#** Battelle Memorial Inst., Columbus, Ohio.
**GLASS COATING OF ELECTRON-BOMBARDMENT ION-THRUSTER GRIDS BY ELECTRODEPOSITION**
John W. Lennon, John E. Reichelderfer, and Dale E. Niesz 13 Jul. 1971 32 p refs
(Contract NAS3-13004)
(NASA-CR-72992) Avail: NTIS CSCL 13H

Parameters affecting the electrodeposition of Corning Code 1723 glass powder to yield controlled fired-coating thicknesses on ion thruster grids were investigated. A set of conditions was determined for producing a fired-coating thickness of 0.041 to 0.051 centimeter, reproducibly, on 30 centimeter-diameter grids. In

processing subsequent to the deposition of the coating, defects developed which were in part attributed to the glass used, the preparation of the coated grid for firing, and the firing temperature. Some comparisons were made of the behavior, in processing, of Code 1723 and Code 7052 glass. Author

**N71-32935#** Bell Helicopter Co., Fort Worth, Tex.
**FLIGHT EVALUATION OF ELASTOMERIC BEARINGS IN AN AH-1 HELICOPTER MAIN ROTOR**
C. H. Fagan Mar. 1971 62 p refs
(Contract DAAJ02-70-C-0020)
(AD-724192; BHC-TR-299-099-485; USAAVLABS-TR-71-16) Avail: NTIS CSCL 13/9

Presented in this report are the results of a flight test program conducted to evaluate elastomeric bearings in the main rotor of an AH-1G helicopter. An experimental main rotor was fabricated and tested using only elastomeric bearings in both the flapping and pitch change axes. With this rotor, the flapping bearings carry the rotor drive and lift loads and allow the flapping motions. Two pitch change bearings were used in each grip to carry the blade bending and shear loads and transfer the blade centrifugal force to the rotor yoke. These bearings also accommodate the blade collective and cyclic pitch change motions. Torsional, radial, and axial load deflection curves are given for the flapping and pitch change bearings. In addition, the results from a limited endurance test program are included for the pitch change bearing. The purpose of the endurance tests was to assure that bearing metal parts would not fail prior to elastomer shredding. Thus, visual inspection of the elastomeric bearings was considered sufficient for safety-of-flight during the test program. The test results have shown the feasibility of elastomeric bearings for helicopter main rotor applications. Author (GRA)

**N71-33004*#** Westinghouse Electric Corp., Pittsburgh, Pa. Astronuclear Lab.
**DEVELOPMENT OF LARGE DIAMETER T-111 (Ta-8-W-2Hf) TUBING Final Report**
D. R. Stoner and R. W. Buckman, Jr. Dec. 1970 142 p refs
(Contract NAS3-10602)
(NASA-CR-72869; WANL-PR-222-001) Avail: NTIS CSCL 13H

Large diameter T-111 (Ta-8W-2Hf) tubing was processed from 5 1/2 inch × 1/2 inch wall seamless and welded tube shells using current state-of-the-art commercial metal working equipment. Twenty feet each of 4 1/4 inch o.d. × 1/8 inch wall and 3 inch o.d. × 0.080 inch wall, weighing a total of 400 pounds with a maximum single continuous length of eleven feet was produced. Tube roundness and dimensional control were better than commerical practice. Both the seamless and weld-reduced tubing were made from a single 2400 pound T-111 ingot. There were no significant differences between the room temperature tensile properties or the 2400 F creep rupture behavior of the seamless and weld-reduced tubing, and the values obtained are comparable to those reported for T-111 sheet product. Author

**N71-33011 #** Dornier-Werke G.m.b.H., Friedrichshafen (West Germany) Entwicklungsabteilung Raumfahrt.
**PROJECT HELIOS: DEVELOPMENT WORK ON AN OIL VAPOR LUBRICATED ANTENNA BEARING SYSTEM [PROJEKT HELIOS: ENTWICKLUNGSARBEITEN AN EINEN OELDAMPFGESCHMIERTEN ANTENNENLAGER]**
G. Baumgartner, M. Granzow, R. Hostenkamp, and H. Wohnhaas Mar. 1971 62 p refs In GERMAN; ENGLISH summary Sponsored by Bundesmin. fuer Bildung und Wiss.
(BMBW-FB-W-71-11) Avail: NTIS; ZLDI Munich: 12.90 DM

The report includes chapters on: selection of oil reservoirs, measurement of oil evaporation in oil reservoirs, outgassing of oil through a small gap in vacuum, optimum friction torque of a ballbearing system. Furthermore procurement plans are given for the components of an antenna bearing. Author (ESRO)

**N71-33142*#** National Aeronautics and Space Administration, Washington, D.C.
**FLUID TECHNOLOGY (SELECTED COMPONENTS, DEVICES, AND SYSTEMS) A Compilation**
1970 19 p refs
(NASA-SP-5938(01)) Avail: NTIS CSCL 13I

Brief summaries are presented of selected components, devices, and systems which may be applied to the design and manufacture of hydraulic and pneumatic components and fluid filtration and calibration systems. Computer programs and data reduction techniques applicable to fluid technology are also included. J.M.

**N71-33215*#** Mechanical Technology, Inc., Latham, N.Y.
**EFFECTS OF VIBRATION AND SHOCK ON THE PERFORMANCE OF GAS-BEARING SPACE POWER BRAYTON CYCLE TURBOMACHINERY. 1: HALF-SINE SHOCK AND SINUSOIDAL VIBRATION**
Paul R. Spencer, Peter W. Curwen, and Henry B. Tryon Washington NASA Jul. 1971 203 p refs
(Contract NASw-1713)
(NASA-CR-1762; MTI-70TR19) Avail: NTIS CSCL 13I

Testing of a high-speed gas-bearing-supported rotor assembly was performed to obtain an initial assessment of the effects of environmental shock and vibration on the mechanical performance of Brayton cycle space-power turbomachinery. Sinusoidal vibration testing was conducted over a frequency range of 5 to 2000 Hz. Shock testing was performed with 10-millisecond half-sine pulses of approximately 20-g peak acceleration. The vibration and shock conditions were applied in three orthogonal directions. Testing was conducted with and without shaft rotation, and with and without the rotor-bearing assembly mounted on vibration isolators. The test results indicate that the specified shock condition should not be a problem for gas-lubricated Brayton cycle space-power turbomachinery. Sinusoidal vibration could be a problem, particularly if imposed while the machinery is running. The use of vibration isolators appears to be a solution to the vibration problems during shutdown (nonrotating) conditions. During rotation, the use of isolators greatly reduces, but may not eliminate, the possibility of vibration-induced bearing contacts. Author

**N71-33226#** National Research Council of Canada, Ottawa, (Ontario). Div. of Mechanical Engineering.
**A STUDY OF FLOW PHENOMENA IN EXTERNALLY PRESSURIZED GAS THRUST BEARINGS**
I. R. G. Lowe Dec. 1970 46 p refs
(NRC-ME-MT-61; NRC-11919) Avail: NTIS

An experimental study of an externally pressurized, gas-lubricated, circular thrust bearing with central admission and operating in the inherent compensation mode is reported. Gas supply pressures covered the range from 1.25 to 4.0 atmospheres (absolute) while clearances varied from 0.0005 inch to 0.005 inch. Three feed-hole radius to bearing radius ratios were investigated: 0.0156, 0.0313, and 0.3. The effect of recess depth was also examined. The film entrance pressure loss has been shown to be a function of several bearing parameters, and an empirical orifice discharge coefficient equation was used to predict load and flow curves for a bearing. Author

**N71-33227#** National Research Council of Canada, Ottawa (Ontario). Div. of Mechanical Engineering.
**PERFORMANCE FACTORS FOR CIRCULAR, HYDROSTATIC, GAS-LUBRICATED THRUST BEARINGS. PART 1: SINGLE INLET THRUST BEARINGS**

E. H. Dudgeon Dec. 1970 47 p refs
(NRC-MT-62; NRC-11941) Avail: NTIS

Procedures are described for the design of both orifice-compensated and inherently-compensated hydrostatic gas thrust bearings. A new empirical correlation for the compensation loss in inherently-compensated bearings is presented. The analytical predictions are compared with experimental results for a number of different single inlet thrust bearings over a range of parameters. The proposed design method is general and can be applied, using appropirate load factors, to multiple inlet thrust bearings. Author

**N71-33281#** Comision Nacional de Investigaciones Espaciales, Buenos Aires (Argentina).

**STUDY OF THE RESPONSE AND STABILITY OF SERVOSYSTEMS UNDER THE INFLUENCE OF NONLINEAR PARAMETERS. VOLUME 1: NATIONAL COMMITTEE OF SPACE INVESTIGATION [ESTUDIO DE LA RESPUESTA Y ESTABILIDAD DE LOS SERVOSISTEMAS BAJO LA INFLUEN: CIA DE SUS PARAMETROS NO-LINEALES, TOMO 1]**

1970 30 p In SPANISH *Its* Informe de Contrato No. 10
Avail: NTIS

The principles for designing nonlinear servosystems are discussed in terms of the response and anomalies. The characteristics studied include: saturation in the amplifier and servomotor, mechanical friction, signal threshold, hysteresis, signal resonance, and harmonics. Methods for simulation by analog computer are also discussed. Transl. by F.O.S.

**N71-33323#** Institute of Technology, Helsinki (Finland). Reactor Lab.

**ON THE USE OF RADIOISOTOPE METHODS OF ANALYSIS FOR QUALITY AND PROCESS CONTROL IN INDUSTRY**

Juhani Kuusi (Ph.D. Thesis) 1970 9 p refs
Avail: NTIS

Methods of X-ray spectrometry and neutron activation analysis using radiation emitted by a radioisotope source are surveyed. The principles underlying X-ray fluorescence analysis and X-ray absorption analysis are described, and the hazards involved are mentioned. The industrial uses of radioisotope source neutron activation analysis are discussed, and neutron generators are considered the nearest alternatives to radioisotope sources. Mossbauer spectrometry is also mentioned, and publications dealing radioisotope X-ray and neutron activation analyses are briefly reviewed. N.E.N.

**N71-33404#** Lund Inst. of Tech. (Sweden). Machine Elements Div.

**ON OPTIMUM DESIGN OF HYDRODYNAMIC LIP SEALS**

Bert Andersson Royal Swedish Academy of Eng. Sci. 1971 67 p refs
(Me-56; UDC-621.822.573-762) Avail: NTIS

Hydrodynamic seals for both unidirectional and bidirectional rotation are studied. The shaft is assumed to be ideally circular, and its surface is assumed to be perfectly smooth. The liquid to be sealed is assumed to be Newtonian and incompressible and the viscosity variations within the film are neglected. Subatmospheric pressures are also neglected. The optimum geometries of the seals are determined. Radial load, power loss, and sealing capacity have been calculated. Tests have been made for sealing capacity and power loss for an optimum unidirectional rotation seal. The agreement between theory and test is quite satisfactory. Additional tests with real seals, made from synthetic rubber, showed that the power loss is smaller for a hydrodynamic seal than for a conventional seal in accordance with the theory. Author

**N71-33480#** Royal Aircraft Establishment, Farnborough (England).

**THE ASSESSMENT OF ELECTRON BEAM WELDED JOINTS [DIE BEWERTBARKEIT ELEKTRONENSTRAHLGESCHWEISSTER VERBINDUNGEN]**

W. Witt et al Jan. 1971 12 p Transl. into ENGLISH from Elektronenstrahlschweiss., DVS Berichte (West Ger.), v. 1, 1967 p 206-213
(RAE-LIB-TRANS-1554) Avail: NTIS

It is necessary to examine electron beam welds both by microscopic examination and by mechanical testing. The strength of the joint may be determined by tensile and notched tensile testing. The deformation behavior of the weld may be assessed by bend testing and with thin materials by cupping tests. These tests together with fatigue tests, can provide information on the suitability of a material for electron beam welding and they can indicate the influence of parent material composition, welding parameters and weld shape on the integrity of the welded joint. Author

**N71-33482*#** Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.

**APPARATUS FOR RECOVERING MATTER ADHERED TO A HOST SURFACE Patent Application**

William W. Paik and Carl P. Chapman, inventors (to NASA) 17 p Filed 7 Oct. 1970
(Contract NAS7-100)
(NASA-Case-NPO-11213; US-Patent-Appl-SN-78703) Avail: NTIS CSCL 13I

An apparatus suitable for recovering matter adhering to a host surface is described. The equipment is characterized by a pickup head having an ultrasonic transducer adapted to deliver ultrasonic pressure waves to impinge against matter adhering to the surface and a vacuum system to recover the separated matter and deliver the matter to a catch basin where it is entrapped to be recovered for examination and/or disposal. NASA

**N71-33515*#** National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

**SURFACE TENSION MEASUREMENTS IN AIR OF LIQUID LUBRICANTS TO 200 C BY THE DIFFERENTIAL MAXIMUM BUBBLE PRESSURE TECHNIQUE**

William R. Jones, Jr. and Lavern D. Wedeven Washington Sep. 1971 19 p refs
(NASA-TN-D-6450; E-6205) Avail: NTIS CSCL 11H

A differential-maximum-bubble-pressure apparatus was used to determine the surface tension of liquid lubricants to 200 C in air. These lubricants included polyphenyl ethers, mineral oils, a synthetic paraffin, a silicone, and a polyether. A polyphenyl ether exhibited the highest surface tension (0.00046 N/cm, 46.0 dynes/cm, at 23 C to 0.000302 N/cm, 30.2 dynes/cm, at 200 C). A polyether exhibited the lowest surface tension 0.000173 N/cm, 17.3 dynes/cm, at 23 C to 0.000082 N/cm, 8.2 dynes/cm, at 200 C). The role of surface tension in heat transfer (cooling) and the effect of surface tension on lubricant starvation in elastohydrodynamic contacts are discussed. Author

**N71-33518*** National Aeronautics and Space Administration. Langley Research Station, Langley Station, Va.

**BORING BAR DRIVE MECHANISM Patent**

James L. Miller, inventor (to NASA) Issued 22 Jun. 1971 7 p Filed 8 Aug. 1968
(NASA-Case-XLA-03661; US-Patent-3,585,882; US-Patent-Appl-SN-751266; US-Patent-Class-408-137; US-Patent-Class-90-11) Avail: US Patent Office CSCL 13I

A portable boring bar drive mechanism featuring a compacted gear train, a common feed and boring bar drive, and an automatic feed stop mechanism is described.
Official Gazette of the U.S. Patent Office

**N71-33635#** Metcut Research Associates, Inc., Cincinnati, Ohio.
**ADAPTIVE CONTROL SURVEY**
John F. Kahles 12 May 1971 113 p refs Prepared for Union Carbide Corp., Oak Ridge, Tenn.
(Contract W-7405-eng-26)
(Y-1759) Avail: NTIS

A comprehensive survey has been made of the present status of adaptive control as it is applied to all types of machining processes. Included is a bibliography of 439 references, a summary of 15 plant visits, and the results of an extensively circulated questionnaire. This survey shows that industry has made little progress in applying adaptive control to the production of parts exhibiting high-quality surface finish and high accuracy. In particular, there is a need for research and development work in the fields of machinability and sensors for obtaining and monitoring very high surface finishes and accuracy. Author

**N71-33603#** Comision Nacional de Investigaciones Espaciales, Buenos Aires (Argentina).
**STUDY OF THE RESPONSE AND STABILITY OF SERVOSYSTEMS UNDER THE INFLUENCE OF NONLINEAR PARAMETERS, VOLUME 2 [ESTUDIO DE LA RESPUESTA Y ESTABILIDAD DE LOS SERVOSISTEMAS BAJO LA INFLUENDIA DE SUS PARAMETROS NO-LINEALES, TOMO 2]**
1970 78 p refs In SPANISH *Its* Informe de Contrato No. 10
Avail: NTIS

The scheme of a servomechanism with a saturable amplifier is considered. The equation for the response of the servosystem is given, and solution results are tabulated. The application of the phase-plane method for determining the dynamic response with nonlinear parameters is discussed. Transl. by F.O.S.

**N71-33680** Cornell Univ., New York.
**STATIC AND DYNAMIC CHARACTERISTICS OF ELECTROMECHANICAL TORQUE MOTORS**
Richard Albert Aubrecht (Ph.D. Thesis) 1970 221 p
Avail: Univ. Microfilms Order No. 70-14370

Small electromechanical devices that convert an electrical current into an output position or force have been manufactured for a number of years. Typical examples of this type of device are relays, moving-coil actuators and torque motors. These devices tend to be developed more by trial and error than by the use of accurate analysis, making the design of new units rather costly and unpredictable. An analytical method that can be used in the design of torque motors is presented. Although the equations developed here are mainly for torque motors, the analytical method and associated computer programs could be used to analyze other types of devices. An analytical model is developed that can be used to predict the static performance characteristics. This nonlinear magnetic flux model relates output force and/or output position to input current. Experimental results are presented and compared with the results obtained from a computer program derived from the nonlinear flux model. Dissert. Abstr.

**N71-33799#** Lund Technical Univ. (Sweden). Div. of Machine Elements.
**THE AXIAL GROOVE JOURNAL BEARING CONSIDERING CAVITATION AND DYNAMIC STABILITY**
Gunnar Lundholm Stockholm Roy. Swedish Acad. of Eng. Sci. 1971 112 p refs Acta Polytech. Scand. Mech. Eng. Ser. No. 58
Avail: NTIS

Hydrodynamic lubrication of the journal bearing with one or two axial oil grooves was studied. The grooves were fed with oil under atmospheric pressure. Sub-cavity pressures were neglected and the viscosity was assumed to be constant. The calculations covered variations of the width-to-diameter ratio, relative eccentricity, and the angle between the oil groove and the direction of the load. The locations of the cavitation regions were found by applying boundary conditions which guaranteed continuity of oil flow. Routh's stability criterion was used for the investigation of the dynamic stability assuming small oscillations. Load capacity, power loss, oil flow, and stability borderlines were given in design charts, from which a bearing with minimum power loss for a given load and with stable running can be designed. Tests were made for stability borderlines, which showed good agreement with the theoretical results. Author

**N71-33829#** National Research Council of Canada, Ottawa, (Ontario). Div. of Mechanical Engineering
**HYBRID COMPUTER STUDY OF A FREE PISTON ENGINE WITH A HYDRAULIC PUMP**
F. Rueter, A. Swiderski and J. Samolewicz Jul. 1970 60 p refs
(NRC-ME-236; NRC-11892) Avail: NTIS

A hybrid computer simulation of a hydraulic pumping engine consisting of a free piston engine coupled pneumatically to a hydraulic pump, is developed and described. The simulation is used to investigate the operation and performance of the engine and its properties, to develop the engine to an optimum configuration, and to predict the effects of various design assumptions on engine performance. Author

# 16 MASERS

**Includes applications of masers and lasers. For basic research see: 26 Physics, Solid State.**

**N71-32857#** Massachusetts Inst. of Tech., Cambridge.
**APPLICATION OF GAS LASERS TO STUDIES OF FUNDAMENTAL MOLECULAR AND ATOMIC PROCESSES Annual Technical Report, 1 Jan. – 31 Dec. 1970**
Ali Javan 12 May 1971 51 p refs
(Contract N00014-67-A-0204-0014; ARPA Order 306)
(AD-724187; AR-3) Avail: NTIS CSCL 20/5

Molecular excitation and relaxation mechanisms are under investigation by a number of techniques. A fluorescence technique for observation of coherent inversion of optical transitions has been used to study relaxation in CO2. Studies of excitation and relaxation processes in transverse and longitudinally excited HF lasers are in progress and results on a transverse room temperature CO laser are also reported. Studies of the pressure broadening and shift of several CO2 transitions are in progress using a standing wave saturation resonance technique. Author (GRA)

**N71-32858#** General Electric Co., Philadelphia, Pa. Re-Entry and Environmental Systems Div.
**DEVELOPMENT OF A LASER PROBE FOR ELECTRON TEMPERATURE Final Report**
H. Sadjian and D. A. Rogers Apr. 1971 104 p refs
(Contract F40600-68-C-0003)
(AD-724180; AEDC-TR-71-69) Avail: NTIS CSCL 14/2

Thomson scattering radiation has been measured in terms of electron concentration and temperature in a free jet facility and a shock tunnel using a 1/2 joule, Q-switched ruby laser. A detector system is described which attenuates the primary ruby wavelength by 10 thousand, discriminates between orthogonal polarization states, analyzes the radiation spectrally and provides a measure of radiation background. The scattering volume was approximately .003 cc for the jet facility and approximately .02 cc cm3 for the

shock tunnel. A temperature range of 3000 to 8000K and an electron concentration range 5 x 10 to the 14th power to 5 x 10 to the 15th power/cc was measured. A unique method of measuring electron temperature is described using a passive system utilizing a retardation plate. Author (GRA)

N71-32874# European Space Research Inst., Frascati (Italy).
**ON THE POSSIBILITY OF PRODUCING 0.1 GeV IONS BY FOCUSSING ULTRASHORT LASER PULSES ON THIN FOILS**
Angelo Caruso and Roberto Gratton 1971 6 p refs
Avail: NTIS

The possibility of creating a high energy neutralized ion beam (energy approximately 1 MeV per nucleon), by a laser pulse, is considered. Author (ESRO)

N71-32980# International Business Machines Corp., Gaithersburg, Md. Federal Systems Center.
**MOLECULAR LASER STUDY Quarterly Technical Summary Report, 1 Aug. 1970 - 31 Jul. 1971**
Bernard G. Smith 31 Jul. 1971 17 p refs
(Contract N00014-71-C-0010; ARPA Order-308)
(AD-724351) Avail: NTIS CSCL 20/5

An intra-cavity absorption experiment was performed and the laser spectra for three different C2H2 pressures in the absorption cell are shown. Further experiments were carried out to characterize the behavior of the laser in the absence and presence of H2. GRA

N71-33023*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
**IMPROVED MASER FOR FREQUENCIES IN THE 7-20 GHz RANGE Patent Application**
Robert C. Clauss and Rex B. Quinn, inventor (to NASA) 20 p Filed 11 Aug. 1970
(Contract NAS7-100)
(NASA-Case-NPO-11437; US-Patent-Appl-SN-63144) Avail: NTIS CSCL 20E

A traveling wave maser (TWM) of the comb type is disclosed for operation in the 7 to 20 GHz frequency range. The TWM is loaded with 0-degree Czochralski grown ruby with its C-axis at angle theta = 90 deg with respect to the magnetic field. The TWM is pumped in the push-push mode between levels 1 to 3 and 3 to 4 in order to minimize changes in the pump and signal frequencies due to ruby misalignment. NASA

N71-33126# Radiation Research Associates, Inc., Fort Worth, Tex.
**TRANSPORT OF LASER RADIATION IN FOGGY AND TURBULENT ATMOSPHERES**
Wolfram G. Blaettner, B. Cecil Thompson, and Michael B. Wells 1 Apr. 1971 37 p refs
(Contract F19628-70-C-0156)
(AD-724200; RRA-T712; AFCRL-71-0229; SR-1) Avail: NTIS CSCL 20/5

Calculations were performed to determine the effect of scattering on the pulse length of a laser beam as it propagates in a foggy atmosphere with a meteorological range of 132.8 meters. For an argon laser with a pulse length of 10 to the minus 10th power seconds it was found that the shape of the laser pulse is not greatly affected by scattering within the foggy atmosphere. A study was made to determine if a Monte Carlo calculation of the energy density distribution in a laser beam would be feasible. The results of the study indicate that a Monte Carlo calculation, based on a random variation of the atmospheric index of refraction along the path of the laser beam, is feasible. It is proposed that a Monte Carlo procedure, based on the techniques outlined in the report, be developed. Author (GRA)

N71-33139# Ballistic Research Labs., Aberdeen Proving Ground, Md.
**ANGULAR DEPENDENCE OF REFLECTIVITIES OF THIN FILM PELLICLES FOR RUBY LASER RADIATION**
Jacob Leeder and Gilbert Bowers Dec. 1970 22 p
(AD-724625; BRL-TN-1748) Avail: NTIS CSCL 20/5

The formulas for the angular dependence of the reflectivities of thin film pellicles as presented by Hillencamp have been extended to pellicles in the lower ranges of available thickness for their possible use as beam splitters for laser radiation. The results are presented in plots for thin film pellicle ranging thickness from 2 to .5 microns and for indices of refraction n = 1.49 and 1.65. Author (GRA)

N71-33150# Army Foreign Science and Technology Center, Charlottesville, Va.
**THE KVARTS PULSED-LIGHT RANGE FINDER WITH LASER [SVETODALNOMER KVARTS OPTICHESKIM KVANTOVYM GENERATOROM SVETA]**
P. E. Lazanov et al 18 Mar. 1971 10 p ref Transl. into ENGLISH from Geod. Kartiografiya (USSR), no. 12, 1969 p 6-9
(AD-724699; FSTC-HT-23-163-71) Avail: NTIS CSCL 17/8

The article describes the Kvarts pulsed-light range finder and its testing. The light source in this range finder is a LG-56 compact laser. The receiver-transmitter weighs about 25 kg. The outfit operates at four modulation frequencies. Measurements were taken during the daytime and nighttime under different meteorological conditions. It was found that for lines 5.3, 11.9 and 22.5 km in length the mean relative errors were 1:390,000, 1:630,000 and 1:780,000. GRA

N71-33152# Army Missile Command, Redstone Arsenal, Ala. Physical Sciences Directorate.
**THERMAL LASER EXCITATION BY SUPERSONIC MIXING IN A GAS DYNAMIC NOZZLE**
H. Lee Pratt 1 Apr. 1971 88 p refs
(AD-723961; RR-TR-71-2) Avail: NTIS CSCL 20/5

An arc-driven laser suitable for gas-dynamic and similar modes of operation is described. Inversion is obtained by rapid expansion of hot gas mixtures through a supersonic aerodynamic nozzle. Upper vibrational lasing levels are frozen at preexpansion conditions while the lower levels are characterized by conditions in the supersonic flow downstream of the nozzle. A population inversion exists for some distance downstream. Inversion is enhanced by the injection of additives to relax the lower levels at a faster rate. The system is so designed that the gases used, the mixture ratios, and the mass flow rates, as well as the specific enthalpy of the system, may be varied nearly independently. In addition, gases may be injected at various points along the flow, and the results of this feature is stressed. The laser has been operated under marginal gas-dynamic conditions with all component gases of a CO2 system premixed prior to expansion. However, most of the work presented deals with the injection of cold CO2 into the hot supersonic flow mixture immediately downstream of the nozzle throat. The report illustrates how parametric studies may be made of various aerodynamic systems. In particular, the effects of controlled amounts of impurities, such as those formed in various combustion processes, may be investigated. GRA

N71-33410* Rocketdyne, Canoga Park, Calif.
**LASER CAMERA AND DIFFUSION FILTER THEREFORE Patent**
Mark J. Olsasky, inventor (to NASA) Issued 28 Jun. 1971 5 p Filed 20 Aug. 1968 Sponsored by NASA
(NASA-Case-NPO-10417; US-Patent-3,587,424; US-Patent-Appl-SN-753974; US-Patent-Class-95-11; US-Patent-Class-331-94.5; US-Patent-Class-352-84) Avail: US Patent Office CSCL 20E

A laser camera system with a diffusion filter is discussed. The diffusion filter is a laser light transparent receptacle containing a suspension of small particles having an average diameter larger than the wavelength of the laser light. The suspension is preferably a colloidal suspension of milk or metal particles in water.
Author

N71-33481# Pennsylvania State Univ., University Park. Dept. of Physics.
**METHODS FOR SPREADING LASER BEAMS**
T. A. Wiggins *In its* Light Scattering and Spectry. Feb. 1971 11 p refs Submitted for publication Supported in part by NSF (See N71-33476 20-14)
Avail: NTIS

Methods for spreading laser beams are described. Beam spreading is often necessary to fill aperture or angle with light of uniform intensity to provide a full field of view in a Fizeau interferometer, to illuminate a sufficient number of rings for obtaining precise measurements with a Fabry-Perot interferometer, or to fill a diffraction grating to achieve maximum resolving power. Four processes may be used for this purpose and use either a diffraction, refraction, reflection, or scattering element. Results of investigations into the relative effectiveness of each of these processes are reported.
A.C.R.

N71-33538# California Univ., Livermore. Lawrence Radiation Lab.
**LASER BEAM FILTERING BY SATURABLE DYES**
R. J. Harrach, T. D. MacVicar, G. I. Kachen, and L. L. Steinmetz 4 Feb. 1971 12 p refs
(Contract W-7405-eng-48)
(UCRL-51008) Avail: NTIS

The utility of filtering a mode-locked laser beam through fast relaxing saturable dyes is studied, both as a coarse-grained diagnostic technique and as a method of improving the ratio of pulse energy to noise energy in the beam. The unamplified beam from a mode-locked and frequency selected Nd-glass laser is found to have 15–20% of the beam energy in a pulse which has a power density of approximately 0.2 GW/sq cm. After filtering the beam through one cm of Kodak 9740 dye, the beam energy is attenuated to 13–15% of its initial value, and 64–72% of this remaining energy resides in the pulse. Similar measurements on a single pulse which had been switched out of the train and amplified by passage through a 1/2-in. × 9-in. rod, results in 25% of the energy being in a pulse which has a power density of approximately 0.9 GW/sq. cm. After filtering through one cm of dye, 26% of the total energy remains, and 82% of this is in the pulse. Any small diameter hot filaments present in the laser beam are likely to self-focus in absorber path lengths > or = to 1 cm.
Author

N71-33541*# Translation Consultants, Ltd., Arlington, Va.
**ADVANCES IN EMISSION SPECTROSCOPIC ANALYSIS USING THE LASER BEAM AS THE EXCITATION SOURCE [RESA BIMU WO REIKIGEN TO SHITE RIYO SURU HAKKO BUNKO BUNSEKI NO SHIMPO]**
Y. Katsuno et al Washington NASA Aug. 1971 24 p refs Transl. into ENGLISH from Japan Analyst, v. 19, 1970 p 1438–1447
(Contract NASw-2038)
(NASA-TT-F-13775) Avail: NTIS CSCL 20E

Recent literature on emissimetry with the laser microprobe is reviewed with emphasis placed on the Jarrell–Ash Mark 2, the Karl Zeiss Jena LMA-1 and the Nippon Electronics JLM-200. Specific improvements including the substitution of neodymium glass for ruby, changes in Q switching and pumping light sources are described. Special features of the Mark 2 and the LMA-1 are compared and the advantages of each discussed. Available crater sizes with and without Q-switching and with reduced or attenuated laser output, and the effects of excitation by laser alone and with auxiliary spark are described. One of the major problems in laser microprobe analysis is the preparation of samples. Such problems and potential solutions are discussed and studies on the effects of the matrix are reviewed and tabular and graphic data given. Examples of applications are provided.
Author

N71-33633*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena. Propulsion Research and Advanced Concepts Section.
**FEASIBILITY OF A NUCLEAR LASER EXCITED BY FISSION FRAGMENTS PRODUCED IN A PULSED NUCLEAR REACTOR**
G. R. Russell *In* Florida Univ. Res. on Uranium Plasmas and Their Technol. Appl. 1971 p 53–62 refs (See N71-33626 20-22)
(Contract NAS7-100)
Avail: SOD $3.75; NTIS CSCL 20E

The role that high-energy particles play in the direct excitation of laser excited states is emphasized. An analysis is presented in which the effects of low-energy thermal electrons and high energy particles are included simultaneously in the populations determination of the excited states of atomic argon irradiated by fission fragments produced in a nuclear reactor.
Author

N71-33666*# Illinois Univ., Urbana.
**ON GAS LASER PUMPING VIA NUCLEAR RADIATIONS**
J. C. Guyot, G. H. Miley, J. T. Verdeyen, and T. Ganley *In* Florida Univ. Res. on Uranium Plasmas and Their Technol. Appl. 1971 p 357–368 refs Sponsored by AEC (See N71-33626 20-22)
Avail: SOD $3.75; NTIS CSCL 20E

Research studies indicate that direct nuclear radiation pumping of certain gas lasers is feasible in the high fluxes provided by a pulsed nuclear reactor. It is further demonstrated that there are significant differences between nuclear radiation pumping and normal electrical excitation. Basic optical absorption and electron density-temperature measurements were undertaken for capitalizing on these differences and obtaining a clear understanding of the mechanisms involved.
E.M.C.

N71-33668*# Florida Univ., Gainesville.
**ENHANCEMENT OF LASER OUTPUT BY NUCLEAR REACTIONS**
F. Allario (NASA, Langley Res. Center), R. T. Schneider, R. A. Lucht (NASA, Langley Res. Center), and R. V. Hess (NASA, Langley Res. Center) *In its* Res. on Uranium Plasmas and Their Technol. Appl. 1971 p 397–400 refs (See N71-33626 20-22)
Avail: SOD $3.75; NTIS CSCL 20E

The effect of nuclear reaction products (including light and heavy particle and gamma rays) on the population inversion of gas lasers is considered with emphasis on molecular and ionic systems. Preliminary experimental results are presented on the enhancement of the output power of CO-2 laser excited by an electric discharge and irradiated by neutrons obtained from a nuclear reactor. The use of high energy particles introduces an additional source of ionization and offers a possibility for operation of laser tubes with larger volumes and higher pressures.
E.M.C.

N71-33786 Arkansas Univ., Fayetteville.
**A STUDY OF SOME EFFECTS OF AN EXTERNAL OPTICAL SIGNAL ACTING ON A LASER OSCILLATOR**
Burton Hargrove Kinsworthy (Ph.D. Thesis) 1970 115 p
Avail: Univ. Microfilms Order No. 70-17183

A theoretical analysis of some nonlinear resonant effects of an external optical signal acting on a laser oscillator is presented. The main topics discussed are subharmonic resonance and frequency entrainment. Optical frequency mixing and har-

monics are also included. The mathematical approach to analysis utilizes the generating solutions from conventional nonlinear resonance theory and the self-consistency principle to obtain nonlinear differential equations which are analyzed for stability by perturbation techniques. These equations yield the amplitudes of the forced oscillations and the corresponding zones of stable operation. The analysis of frequency entrainment demonstrates that the operating frequency of all laser oscillators can be entrained by an external optical signal. The results of the entrainment analysis are displayed in a response characteristic.
Dissert. Abstr.

N71-33820# Office National d'Etudes et de Recherches Aerospatiales, Paris (France.)
**AUTOMATIC POINTING OF A TELEMETRIC LASER TIMER [POINTAGE AUTOMATIQUE DES TELEMETRES A LASER DECLENCHE]**
Roland Moreau 1971 14 p refs in FRENCH Presented at meeting of AGARD on Space Avionics, Rome, 31 May–4 Jun. 1971
(TP-964) Avail: NTIS
Various automatic tracking systems are reviewed: (1) programmed tracking through ephemerides; (2) independent tracking utilizing remote measured data; and (3) semi-automatic tracking. For each system the acquisition period was extensively studied, especially in the case of the geostationary satellites. Lastly the effect of the pulse frequency was analyzed for cases when there is a partially random displacement of the target.
Author

# 17 MATERIALS, METALLIC

Includes cermets; corrosion; physical and mechanical properties of materials; metallurgy; and applications as structural materials. For basic research see: 06 Chemistry. For related information see also: 18 Materials, Nonmetallic; and 32 Structural Mechanics.

N71-32953# Gillette Research Inst., Inc., Rockville, Md.
**EVALUATION OF THE ADHESIVE BONDING PROCESSES USED IN HELICOPTER MANUFACTURE. PART 2: THE CHARACTERIZATION OF ADHERENT SURFACES**
Willard C. Hamilton and George A. Lyerly Mar. 1971 68 p refs
(Contract DAA21-70-C-0434)
(AD-724663; PA-TR-4185-Pt-2) Avail: NTIS CSCL 13/8
Surfaces of titanium 6-aluminum, 4-vanadium alloy, commercial pure titanium grade 3, 2024 T-3 and 6061 T-6 aluminum alloys bare, and 2024 T-3 aluminum alloy clad were examined at selected stages in the prebonding treatment of these metals. Variations in the film morphology were observed directly in a scanning electron microscope, and, after removal, in a transmission electron microscope. Film thickness measurements were made with transmission and reflectance interference microscopes. Chemical compositions of these films were determined by photoelectron spectroscopy, electron diffraction, and nondispersive X-ray fluorescence analysis. Contact angles and surface potential measurements were also used to characterize these metal surfaces. The results obtained suggest that bonding differences with the variously treated titanium alloys were caused by variations in the crystalline structure of the titanium dioxide, whereas bonding differences with the aluminum alloys were caused by variations in surface hydration, film thickness, and surface morphology.
Author (GRA)

N71-33091# National Science Foundation, Washington, D.C.
**DIFFUSION OF IRON IN MAGNETITE [DEFFOOZIYA ZHELEZA V MAGNETITE]**
V. I. Izvekov 1970 12 p refs Transl. into ENGLISH from Izh. Fiz. Zh., Akad. Nauk Belorussk. SSR (Minsk), no. 1, 1958 p 64–68
(TT-70-59100; DMDC-5806) Avail: NTIS CSCL 11F
A method is proposed for determining the coefficient of diffusion of iron in magnetite. Within the volume of the lattice and boundary surfaces, the layer removal method is used for determining the diffusion process of iron in magnetite prepared from powdered oxide with grains on the order of 1 to 10 microns in diameter. Results are compared with data from absorption measurements.
Author (GRA)

N71-33113# Aerospace Research Labs., Wright-Patterson AFB, Ohio.
**EROSION OF DUCTILE MATERIALS BY IMPACTION OF SOLID PARTICLES Final Report, Mar.–Jun. 1970**
Robert G. Surette Jan. 1971 51 p refs
(AD-724116; ARL-71-0019) Avail: NTIS CSCL 20/11
A theoretical model for the erosion of ductile materials by impaction of solid particles is developed. The model uses parameters based on well known properties of the materials. Qualitative and quantitative results in good agreement with experiments are obtained for spherical particles.
Author (GRA)

N71-33122# Battelle Memorial Inst., Columbus, Ohio.
**TECHNICAL ECONOMIC EVALUATION OF AIR POLLUTION CORROSION COSTS ON METALS IN THE US Final Report**
F. W. Fink, F. H. Buttner, and W. K. Boyd 19 Feb. 1971 162 p refs
(Contract CPA-70-86)
(PB-198453; APTD-0654) Avail: NTIS CSCL 13B
The added cost of corrosion damage resulting from the exposure of metallic systems and structures to polluted atmospheres, both presently and by 1980 was assessed. An approach was devised, employing applicable national shipment/value data from the U.S. Department of Commerce to compute average pollution costs on a national basis. Data developed by the Census Bureau in the Standard Industrial Classification (SIC) were cross checked where possible with industry association statistics. The results were then applied to a formula, which relates value with air pollution damage to metals in use, and which makes it possible to compute corrosion damage accurately on a national scale. The Department of Commerce statistics are broken down into thousands of metal components of varying degrees of interest. Accordingly, the full array was put through a series of qualitative and finally quantitative screening steps to select only those systems having a high potential of economic loss due to their numbers and their in service vulnerability to air pollution corrosion damage. From a corrosion viewpoint, the most important pollutants are sulfur dioxide and four estimates are presented for the sulfur dioxide levels in 1980.
Author

N71-33127# General Motors Research Labs., Warren, Mich. Materials and Structures Lab.
**CHARACTERIZATION OF THREE ALUMINUM ALLOYS Final Report, 30 Jun. 1969–15 May 1970**
S. G. Babcock, J. J. Langan, D. B. Norvey, T. E. Michaels, F. L. Schierloh et al Jan. 1971 123 p refs
(Contract DAAG46-69-C-0127)
(AD-724195; MSL-70-12; AMMRC-CR-71-3) Avail: NTIS CSCL 11/6
The dynamic behavior of three aluminum alloys: 6061-T6, 2014-T6 and 2024-T3, is described from experimental tests in three areas: (1) Effect of prestraining on the subsequent yield surface in biaxial stress. (2) Effect of heating rate or time-at-temperature on the yield and flow stress behavior in uniaxial stress, and (3) Shock wave response where elastic constants, hugoniot equation

of state, wave profiles, and spallation thresholds were determined. Experimental techniques are fully described with emphasis on data interpretation within the limitations of the experiments. Results are presented with analysis and discussion related to current theoretical formulations. Author (GRA)

**N71-33177#** National Science Foundation, Washington, D.C. Special Foreign Currency Science Information Program.
**THE STUDY OF THE EFFECT OF ANNEALING AT A TEMPERATURE 1200 C ON THE ACTIVATION ENERGY OF CHROMIUM DIFFUSION IN Fe-Cr ALLOYS [ISSLEDOVANIE VLIYANIYA OTZHIGA PRI TEMPERATURE 1200C NA ENERGIYU AKTIVATSII DIFFUZII KHROMA V ZHELEZO-KHROMOVYKH SPLAVAKH]**
A. G. Lesnik 1970 9 p Transl. into ENGLISH from Akad. Nauk URSR, Kiev, Inst. Metallofizyky, Sb. Nauchn. Rabot (Kiev), no. 5, 1954 p118–122
(TT-70-59105; DMDC-5814) Avail: NTIS CSCL 11F

Diffusion of chromium was studied in iron-chromium alloys. Samples made out of alloys, measuring 2×1×0.5 cm were soldered inside quartz ampules then annealed at different intervals of time at temperature 1200C. After annealing, the surface of the samples was polished and then foils 10 to 30 microns thick were cut for the determination of diffusion coefficient by the method of evaporation in a vacuum. The diffusion coefficient was determined in the temperature range of 950 to 1120C for 5 to 8 temperature points, the observation for each point was repeated at least twice. Author (GRA)

**N71-33178#** National Science Foundation, Washington, D.C. Special Foreign Currency Science Information Program.
**RELAXATION OF TENSION AND IRREGULAR DIFFUSION MOBILITY IN POLYCRYSTALLINE AUSTENITE Fe-Cr-Ni ALLOYS [RELAKSIYA NAPRYAZHENII I NERAVNOMERNOST DIFFUZIONNOI PODIZHNOSTI V POLIKRISTALLICHESKIKH AYUSTENITNYKH ZHELEZOKHROMONIKELEVYKH SPLAVAKH]**
V. I. Arkharov 1970 16 p refs Transl. into ENGLISH from Akad. Nauk SSSR, Ural. Filial, Sverdlovsk, Inst. Fiz. Metallov, Tr. (USSR), no. 19, 1958 p 23–42
(TT-70-59110; DMDC-5821) Avail: NTIS CSCL 11F

The mobility of atoms in solids at higher temperatures calls forth a series of its physical properties. Special interest involves the study of the mobility of atoms, on the boundaries of grains, which is characterized by coefficient of diffusion on the boundaries D sub b. During measurements with the help of radioactive tracers, the graph is plotted for the dependence of integral activity N(x) against the penetration depth x, and then the value dN/dx = i, proportional to the concentration C is determined. The diffusion of cobalt in steel was studied. Author (GRA)

**N71-33198#** National Science Foundation, Washington, D.C.
**STUDY OF COBALT AND IRON DIFFUSION ON THE BOUNDARIES OF COBALT, NICKEL AND IRON GRAINS [ISSLEDOVANIE DIFFUZII KOBALTA I ZHELEZA PO GRANITSAM ZEREN KOLEALTA, NIKELYA I ZHELEZA]**
S. D. Gertsriken 1970 37 p refs Transl. into ENGLISH from Sb.-Nauchn. Rabot. Inst. Metallofiz. Akad. Nauk Ukr. SSR (Kiev), no. 9, 1959 p 154–161
(TT-70-59108; DMDC-5817) Avail: NTIS CSCL 11F

The processes of plastic deformation in polycrystalline material are developed under high temperatures in bordering zones of crystals (in the zones adjacent to inter-crystallite borders). They consist of elementary processes similar to elementary diffusion laws in crystal lattice. For the selected Fe-Cr-Ni alloys of the study such alloying elements are chromium, nickle, cobalt and also manganese. Since direct study of diffusion processes in boundary layers of very small thickness (of the order of 100-1000A) is extremely difficult, an attempt was made to study diffusion processes by frontal diffusion. Author (GRA)

**N71-33228#** Royal Aircraft Establishment, Farnborough (England).
**THE EVALUATION OF FLOW CURVES OF METALLIC MATERIALS [ERMITTLUNG DER FLIESSKURVEN METALLISCHER WERKSTOFFE]**
W. Panknin Apr. 1971 23 p refs Transl. into ENGLISH from VDI Berichte, v. 87, 1964 p 12–17
(RAE-LIB-TRANS-1569) Avail: NTIS

The recording of flow curves in tensile tests (with and without prestraining) and in compression tests is fully described. They can be simply calculated from the load-elongation curves recorded in tensile or compression tests. The flow curve can be recorded directly during the tests by means of an analogue computer. It is possible, by an approximate method, to determine the flow curves of a series of materials such as steel and aluminum simply from the flow stress and the uniform elongation. Author

**N71-33234*#** Stanford Research Inst., Menlo Park, Calif.
**CHEMICAL AND METALLURGICAL ANALYSES OF 6 Al-4V TITANIUM TEST SPECIMENS EXPOSED TO HYDRAZINE ($N_2H_2$) LIQUID PROPELLANT**
W. E. Tolberg, R. T. Rewick, and M. P. Dolder 15 Apr. 1971 30 p refs Prepared for JPL
(Contracts NAS7-100; JPL-951581; SRI Proj. PYD-6063)
(NASA-CR-121456; SRI-951581-11) Avail: NTIS CSCL 11F

Tests capsules containing $N_2H_4$ and Ti(6Al-4V) were analyzed both chemically and metallurgically for decomposition and corrosion. A high chloride and carbon impurity was found in the $N_2H_4$. Freon TF used as a degreasing solvent was shown to react with $N_2H_4$ forming hydrazine monohydrochloride. It is concluded that the monohydrochloride causes both the corrosion of the titanium alloy and the decomposition of some of the hydrazine. The recommendation is made that $N_2H_4$ be analyzed by the iodate method. The addition of break seals which would allow for final analysis on a vacuum line is recommended. Author

**N71-33248*#** National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
**A REVIEW OF SURFACE SEGREGATION, ADHESION AND FRICTION STUDIES PERFORMED ON COPPER-ALUMINUM, COPPER-TIN AND IRON-ALUMINUM ALLOYS**
John Ferrante and Donald H. Buckley 1971 18 p refs Proposed for presentation at Lubrication Conf., Pittsburgh, Pa., 5-7 Oct. 1971; sponsored by the Am. Soc. of Lubrication Engr. and the Am. Soc. of Mech. Engr.
(NASA-TM-X-67900; E-6385) Avail: NTIS CSCL 11F

A review of the results of Auger emission spectroscopy, low energy electron diffraction, adhesion and friction experiments on a number of alloys is presented. The alloys discussed were single crystals of Cu-10 a/o Al, Cu-5 a/o Al, Cu-1 a/o Al, Cu-1 a/o SN, and a polycrystalline sample of Fe-10 a/o Al. In all cases the minor constituent segregated at the surface in quantities much higher than the bulk concentration producing markedly altered adhesion and friction behavior. The observations in these studies indicate that bulk compositions should not be assumed to hold in experiments involving surfaces. Author

**N71-33327#** National Science Foundation, Washington, D.C.
**MECHANISM OF DIFFUSION OF SOME ELEMENTS IN IRONS AND STEELS [DIFFOOZIYA I MEZHATOMNOE VZAIMODEISTVIE V SPLAVAKH NA OAENOVE PEREKHODNEKH ELEMENTOV GROOPPEE ZHELEZA]**
I. Ya. Dekhytatar 1970 22 p refs Transl. into ENGLISH from

Sb. Nauchn. Rabot, Metallofiz., Akad. Nauk Ukr. SSR (Kiev), no. 8, 1957 p 77–90
(TT-70-59107; DMDC-5816) Avail: NTIS CSCL 11F

The interrelation between atomic transference and movement of electrons in lattice of metals which is characterized by electroatomic interaction is investigated. Author (GRA)

**N71-33399*#** Lockheed Missiles and Space Co., Sunnyvale, Calif.
**ALLOYING OF CHROMIUM TO RESIST NITRIDATION**
**Final Report**
R. A. Perkins Jul. 1971 204 p refs
(Contract NAS3-13210)
(NASA-CR-72892; LMSC-D008017) Avail: NTIS CSCL 11F

The results are presented of an investigation to determine the most effective alloy additions for controlling the nitrogen embrittlement of chromium and to identify the mechanism(s) by which embrittlement is reduced. Based on bend ductile-to-brittle transition temperature, additions of 1 to 2 at.% rare earths or thorium give the best resistance to embrittlement. Their effectiveness is increased by the addition of 2 to 3 at.% zirconium. These elements promote ductile behavior in nitrogen-contaminated chromium by providing a dispersion of secondary phases (oxides, nitrides, intermetallics, or excess metal) that is capable of activating dislocation sources. Author

**N71-33408*** National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
**CORROSION RESISTANT BERYLLIUM Patent**
Patricia M. O'Donnell, inventor (to NASA) Issued 6 Jul. 1971 2 p Filed 30 Oct. 1968
(NASA-Case-LEW-10327; US-Patent-3,591-426; US-Patent-Appl-SN-772006; US-Patent-Class-148-6.3) Avail: US Patent Office CSCL 11F

A method for preventing corrosion of beryllium as elevated temperatures by applying a fluoride coating is described. The beryllium is heated and then reacted with fluorine. This process coats the surface with a beryllium fluoride film of the insoluble rhombic tridymite form. Author

**N71-33576#** National Science Foundation, Washington, D.C. Special Foreign Currency Science Information Program.
**STUDY OF IRREGULARITIES IN DIFFUSION FRONT OF NICKLE IN POLYCRYSTALINE Fe-Cr-Ni ALLOYS [ISSLEDOVANIE NERAVNOMERNOSTEI FRONTALNOI DIFFUZII NIKELYA V POLIKRISTALLICHESKIKH ZHELEZOKHROMONIKELEVYKH]**
V. I. Arkharov 1970 12 p refs Transl. into ENGLISH from Tr. Inst. Fiz. Metall. (USSR), no. 19, 1958 p 122–126
(TT-70-59111; DMDC-5822) Avail: NTIS CSCL 11F

Results obtained during the comparison with experimental data regarding diffusion of nickel in alloys with the data about relaxation of tension in the same alloys, confirm the ideas developed by V. I. Arkharov and M. V. Yakutovich. Addition of small positively active admixtures in solid solution leads to the enrichment of inter-crystalline zones by introduced admixtures as compared to the grain mass. This may explain reduction of diffusion mobility along with the borders of grains and also the reduction in the intensity of course of plastic deformation along intercrystalline zones. In other words the notions are proved which say that under high temperature deformation, a substandtial role is played by intercrystalline zones and that with small positively active admixture we may exert influence on the properties of the metal as a whole. Author (GRA)

**N71-33645*#** Florida Univ., Gainesville.
**BOILING POINT OF URANIUM**
A. G. Randol, III (Nucl. Fuel Serv., Inc.), R. T. Schneider, and C. D. Kylstra *In its* Res. on Uranium Plasmas and Their Technol Appl. 1971 p 181–185 refs (See N71-33626 20-22)
Avail: SOD $3.75; NTIS CSCL 11F

Current techniques for boiling-point determinations rely on extrapolation of low-temperature vapor pressure data (usually collected below 2500 K) through the Clausius-Clapeyron equation. Since the temperature limitation is, in most cases, difficult to overcome, it is necessary to rely heavily on indirect methods for the evaluation of boiling points. Under special environment conditions there is evidence that an interpretation of uranium plasma electrical characteristics can lead to reasonable estimates of the boiling point. The device used to generate the uranium plasma, a high-pressure uranium arc, is described. Details of the electrical power, cooling, high-pressure, gas, and data-acquisition systems are given. A modification of the Nottingham equation for electric arc potential versus current is presented. The application of this arc electrical characteristics model is discussed in terms of the determination of the boiling point of the uranium anode. The evaluated boiling points of uranium between 1 and 7 atm are compared with the extrapolations of other authors. Author

**N71-33688#** National Science Foundation, Washington, D.C. Special Foreign Currency Science Information Program.
**A STUDY OF SELF-DIFFUSION IN METALS IN THE AREA OF PHASE TRANSITIONS [ISSLEDOVANIE SAMODIFFOOZII METALLOV V OBLASTI FANZOVEKII PEREKHODOV]**
N. A. Bogdanov 1970 18 p refs Transl. into ENGLISH from Tr. Inst. Metall., Sverdlovsk (USSR), no. 15, 1963 p 138–146
(TT-70-59112; DMDC-5846) Avail: NTIS CSCL 11F

The main interest of the investigation was to study self-diffusion of metals containing polymorphine transformations, out of which mostly steel and its alloys were studied. In spite of a huge volume of work devoted to the study of self-diffusion in steel, the question still requires additional study. Fundamentally there has been little study on self-diffusion of steel in temperature range of 0.50 degree higher than the temperature for polymorphine transformation i.e., in the range of phase transitions (910-960 deg.). Results of different research workers do not agree with one another. Authors come to the conclusion that temperature dependence of logarithmic coefficient of self-diffusion of iron is supposed to be linear with steep fall at 910 C, after which again increases linearly with the increase of temperature. Any transition zone was not located by them. Author (GRA)

**N71-33764#** General Electric Co., St. Petersburg, Fla. Neutron Devices Dept.
**PRODUCTION OF BULK QUANTITIES OF ULTRAPURE ERBIUM**
N. H. Parsons 10 Mar. 1971 19 p ref
(Contract AT(29-2)-656)
(GEPP-85) Avail: NTIS

A vacuum distillation operation is described for the reprocessing of erbium. This distillation method is capable of increasing the purity of commercially available erbium up to 99.96 wt % by mass spectrographic analysis. Author (NSA)

**N71-33821** West Virginia Univ., Morgantown.
**AN INVESTIGATION OF THE REPORTED KNIGHT SHIFT ANOMALY IN METALLIC SODIUM**
Ralph Lawrence Stenger, Jr. (Ph.D. Thesis) 1969 58 p
Avail: Univ. Microfilms Order No. 70-15267

The Knight shift in metallic sodium was measured over a temperature range from 4.2 to 70 K in an effort to gain some insight into the low-temperature anomaly reported by Feldman. The results indicate that the behavior reported by Feldman is not characteristic of metallic sodium. Those terms which are believed to be responsible for the temperature-dependent Knight shift are

discussed. Numerical estimates obtained by Feldman are compared with the measurement results. The experimental setup included a Robinson spectrometer, magnetic field and spectrometer frequency controllers locked to a stable 10 MHz crystal oscillator, and a digital frequency counter. Suggestions for extending the technique to absolute measurements are discussed. Dissert. Abstr.

**N71-33888#** Oak Ridge National Lab., Tenn.
**EVALUATION OF THE MOLTEN-SALT REACTOR EXPERIMENT HASTELLOY N SURVEILLANCE SPECIMENS: FOURTH GROUP**
H. E. McCoy, Jr. Mar. 1971 91 p refs
(Contract W-7405-eng-26)
(ORNL-TM-3063) Avail: NTIS

Two heats of standard Hastelloy N were removed from the core of the MSRE after 22,533 hr at 650 C and exposed to a thermal fluence of 1.5 × 10 to the 21st power neutrons/sq cm and a fast fluence >50 keV of 1.1 × 10 to the 21st power neutrons/sq cm. The mechanical properties have systematically deteriorated with increasing fluence. However, the change in properties is due to the helium produced by the B-10(n,alpha)Li-7 transmutation and can be reduced by changes in chemical composition. Some of these modified heats were exposed to the core of the MSRE and show improved resistance to irradiation. The corrosion of the Hastelloy N was largely due to the selective removal of chromium. The rates of removal are much as predicted from the measured diffusion rate of chromium. Other superficial structure modifications were observed, but they likely result from carbide precipitation along slip bands that were formed during machining. Author (NSA)

**N71-33928** Drexel Inst. of Tech., Philadelphia, Pa.
**CORRELATION OF SUBSTRUCTURAL ASPECTS AND MECHANICAL BEHAVIOR IN ALUMINUM STAINLESS STEEL FIBER REINFORCED COMPOSITES**
Michael Robert Pinnel (Ph.D. Thesis) 1970 199 p
Avail: Univ. Microfilms Order No. 70-17397

Stress-strain behavior and associated substructural details have been correlated in aluminum stainless steel, vacuum hot-pressed, continuous fiber composites stressed in uniaxial tension or compression. Volume fractions of 4.1, 11.0, 15.3, 21.2, 24.8, and 32.8 percent have been characterized mechanically in the microyielding and macroyielding regions. Particular emphasis was placed on the premacroyield region. Associated dislocation configurations have been characterized as a function of overall composite strain, volume fraction of reinforcement, and distance into the matrix from the matrix-fiber interface. Dissert. Abstr.

**N71-33932** Clemson Univ., S.C.
**THE THIRD AND FOURTH ORDER ISOTHERMAL ELASTIC CONSTANTS OF COPPER AND NICKEL**
Michael William Riley (Ph.D. Thesis) 1969 99 p
Avail: Univ. Microfilms Order No. 70-17454

A general approach is presented for relating the results of tensile experiments to the second, third and fourth order elastic coefficients. A tensile apparatus was constructed which used a differential technique and was sufficiently sensitive to measure deviations from Hooke's law. Cu whiskers were used whose growth axes were in the <001>, <101> and <111> directions, and Ni whiskers whose growth axes were in the <001> direction. The results may be expressed as xi = P/E + delta (P/E)sq + zeta (P/E)cu, where xi is the extension, E is Young's modulus and P is the force applied per unit initial area. Using the experimental values for delta and the pressure derivatives of the second order elastic constants, six third order isothermal elastic constants for Cu and three third order constants for Ni were evaluated. Dissert. Abstr.

**N71-33955** Maryland Univ., College Park.
**BASIC MECHANISMS IN THE OXIDE FILM FORMATION OF PLASMA ANODIZED ALUMINUM**
Gerald David Slawecki (Ph.D. Thesis) 1969 113 p
Avail: Univ. Microfilms Order No. 70-15383

The mechanisms in the plasma anodization of aluminum are discussed. The basic equipment that was designed and constructed to accomplish this end was similar to commercially available forms of sputtering equipment in that it could operate between (−1) and (−11) torr, vapor deposit and ion bombard specimens, allow separate shielded biases of 300 to 3000 volts, and 0 to 50 volts, with current measurements of 25 to 250 ma, and (−1) to (−9) amps respectively, admit 3 different gases at (−6) torr liter/sec., and allow continuous pressure measurements from (−1) to (−10) torr. With this equipment, techniques were developed to isolate the effect of the significant variables upon the rates of growth and of sputtering of aluminum oxide films. It was found that the rate of growth depends primarily upon specimen current in the constant current mode. Dissert. Abstr.

# 18 MATERIALS, NONMETALLIC

Includes corrosion; physical and mechanical properties of materials (e.g., plastics); and elastomers, hydraulic fluids, etc. For basic research see: 06 Chemistry. For related information see also: 17 Materials, Metallic; 27 Propellants; and 32 Structural Mechanics.

**N71-32943*#** National Materials Advisory Board, Washington, D.C.
**ACCELERATING UTILIZATION OF NEW MATERIAL**
May 1971 107 p refs Sponsored in part by NASA
(Contract DA-49-083-OSA-3131)
(NASA-CR-121375; NMAB-283) Avail: NTIS CSCL 11D

Because of concern regarding the slow rate of introducing new materials into national programs, the National Materials Advisory Board sought to identify the factors that promote or inhibit their use. The advantages to be derived from new materials are documented. Case histories of past material introductions are discussed. Using these histories as a foundation, the factors that constrain or which promote progress in introducing new materials into hardware are identified. The constraints and promoters are organized into four categories; technical, economic, contractual, and management and organization. Recommendations are included. Author

**N71-32962#** Army Foreign Science and Technology Center, Washington, D.C.
**THE DESTRUCTION OF HYDROLYTIC LIGNIN [O DEKTRUKTSH GIDROLIZNOGO LIGNINA]**
G. D. Ponurov 14 Oct. 1970 11 p refs Transl. into ENGLISH from Akad. Nauk SSSR Izv. Ser. Biol. (USSR), v. 34, no. 4, 1969 p 48–51
(AD-713924; FSTC-HT-23-977-70) Avail: NTIS CSCL 11/12

An investigation is presented of the destruction of hydrolytic lignin by wood-destroying fungi and the analysis of lignin preparates as additives to improve soil. GRA

**N71-32979#** Chemical Systems, Inc., Santa Ana, Calif.
**HEAT RESISTANT POLYMERS CONTAINING THE LOW MOLECULAR WEIGHT CLOSO-CARBORANES. 3: THE PREPARATION OF POLYCARBORANESILOXANE POLYMERS BY ALCOHOLYSIS**
Robert E. Kesting, Kenneth F. Jackson, and James M. Newman

1 Apr. 1971 10 p refs
(Contract N00014-70-C-0109)
(AD-724350; TR-4) Avail: NTIS CSCL 7/2

A new synthesis for carboranesiloxane polymers has been discovered. It involves the alcoholysis of the bis-chlorodimethylsilyl carborane monomers and the generation of the HCl catalyst in situ. Alcoholysis is applicable to the synthesis of most carboranesiloxane polymers with the exception of the SiB-1 homopolymers of the larger carboranes. The attack of the B-H moieties in the carborane cage can be minimized by the utilization of a tertiary alcohol or by the addition of excess acid when a primary alcohol is employed. Author (GRA)

N71-33041# Naval Research Lab., Washington, D.C.
**AN EVALUATION OF NONLINEAR OPTICAL MATERIALS BY THE SECOND HARMONIC POWDER TECHNIQUE Final Report**
J. F. Giuliani, L. S. Goldberg, and F. Von Batchelder 29 Apr. 1971 10 p refs
(ARPA Order-306)
(AD-724300; NRL-7273) Avail: NTIS CSCL 20/6

The nonlinear optical properties of 21 crystalline materials, principally of the iodate family of compounds, were evaluated using the second-harmonic powder technique developed by Kurtz and Perry. By this method the second-harmonic radiation generated in a powdered sample by a laser at 1.06 micrometers was compared with a known reference, LiIO3 in this case. Of the materials tested, 12 have previously been reported on in the literature, and the present results are in substantial agreement. KIO3 and RbIO3 are identified as having the most promise for crystal development effort. The remaining materials, observed for the first time, failed to exhibit appreciable second-harmonic intensity. Author (GRA)

N71-33060# Air Force Systems Command, Wright-Patterson AFB, Ohio. Materials Lab.
**FREE EDGE EFFECTS IN THE MEASUREMENT OF COMPOSITE IN-PLANE SHEAR PROPERTIES Technical Report, Jun. – Sep. 1970**
James M. Whitney Feb. 1971 27 p refs
(AD-724146; AFML-TR-70-282) Avail: NTIS CSCL 11/4

A Fourier series solution is obtained for the stresses in a symmetrically laminated orthotropic plate subjected to a uniform tangential displacement along one edge with the opposite edge clamped and the two adjacent edges stress-free. These are essentially the edge conditions imposed by the rail shear test. Results can also be applied to the determination of stresses in a certain class of bonded double lap joints. Numerical examples show the shear stress distribution to be a function of various in-plane stiffness ratios and the dimensions of the plate. In addition, normal stresses of large magnitude are found in the corners. Theoretical results are qualitatively verified on fiber reinforced rubber composites. Author (GRA)

N71-33065# Ceramic Finishing Co., State College, Pa.
**STRENGTHENING OXIDES BY REDUCTION OF CRYSTAL ANISOTROPY**
Henry P. Kirchner and Robert M. Grover Apr. 1971 60 p refs
(Contract N00014-68-C-0190)
(AD-724315; TR-5) Avail: NTIS CSCL 11/2

In single phase polycrystalline ceramic bodies composed of anisotropic crystals the stresses resulting from applied loads, large scale residual stresses and localized stresses combine to cause fracture. The localized stresses caused by crystal anisotropy are substantial in magnitude and in large grain size bodies cause local crack formation even in the absence of an applied load. In earlier investigations compositions with reduced thermal anisotropy were made by solid solution additions. In the present investigation the flexural strengths of alumina ceramics, and of a composition in the system Al2O3-Cr2O3 having reduced thermal anisotropy, were compared over a range of grain sizes in the machined and quenched conditions. The fracture surfaces were studied. Very high strengths were observed. Author (GRA)

N71-33100# Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Brunswick (West Germany). Inst. fuer Flugzeubau.
**STRENGTH OF ADHESIVE BONDS OF CARBON FIBER REINFORCED COMPOSITES [FESTIGKEITSVERHALTEN VON KLEBVERBINDUNGEN AUS KOHLENSTOFFASERVERSTAERKTEN KUNSTSTOFFEN (KFK)]**
Walter Althof Apr. 1971 36 p ref In GERMAN; ENGLISH summary
(DLR-FB-71-31) Avail: NTIS

Structural components of carbon fiber reinforced composites are adhesive bonded to each other as well as to aluminum, steel, and titanium. The strength properties of these joints were investigated, using aircraft structural adhesives only. The test results showed relations between joint strength, adhesive ductility, and interlaminar strength of the composite. Author (ESRO)

N71-33128# National Bureau of Standards, Washington, D.C. Inst. for Materials Research.
**ARPA-NBS PROGRAM OF RESEARCH ON HIGH TEMPERATURE MATERIALS AND LASER MATERIALS Technical Note, 1 Jul. – 31 Dec. 1970**
A. D. Franklin and H. S. Bennett, eds. Apr. 1971 49 p refs
(ARPA Order 363-62)
(AD-724662; NBS-TN-574) Avail: SOD $0.50; NTIS CSCL 11/2

Progress reports are given for projects on the growth of ultra-pure Al2O3 crystals, the development of a mass spectrometer-based sectioning technique for measuring oxygen diffusion in oxides, the development of a precision facility for measuring the threshold energy in a laser beam producing damage in a transparent substance, and the study of the factors influencing this damage threshold in glass. Author (GRA)

N71-33194# Naval Ammunition Depot, Crane, Ind.
**RADIATION INDUCED POLYMERIZATION. 1: A PYROTECHNIC BINDER**
William T. Biggs and Clyde F. Parrish 24 Mar. 1971 28 p refs
(AD-724652; NAD-CR-RDTR-182) Avail: NTIS CSCL 19/1

It is the intent of the work described in the report to illustrate a process which readily lends itself to an irradiation curing process, viz., the production of pyrotechnic materials such as flares. Production methods used to date suffer heavily from the lack of automation and present many inherent safety hazards, many of which are based on the requirement that many of the production operations must be handled by individuals, in particular, the batch mixing processes. It has been the intent of the work described here to illustrate that: Such a method of producing pyrotechnic materials is feasible; and this method produces items that can be applied to future uses. Author (GRA)

N71-33496# National Aeronautical Establishment, Ottawa (Ontario).
**THE EFFECT OF PROCESS CONDITIONS ON TENSILE PROPERTIES OF A DGEBA AND A PHENOL NOVOLAC RESIN REACTED WITH AN ADDUCT OF METHYLENEDIANILINE AND PHTHALIC ANHYDRIDE**
P. D. McLean and R. F. Scott Natl. Res. Council May 1971 41 p refs
(NRC-MS-132; NRC-12091) Avail: NTIS

The preparation of an anhydride amine adduct from phthalic anhydride and methylene dianiline and its use as a crosslinking agent are presented. The exotherms and crosslinking times for a variety of reacting compositions were determined. The results of a study on the effect of process conditions on the tensile strength, elongation, and modulus of elasticity are reported. Author

N71-33594*# George Washington Univ., Washington, D.C.
**REVIEW OF FEDERAL RESEARCH AND DEVELOPMENT IN PAVEMENT STRIPING MATERIALS**
30 Jul. 1971 119 p refs
(Contract NASw-2055)
(NASA-CR-121412) Avail: NTIS CSCL 11D

A summary is presented of information gathered on federal R&D efforts directly relevant to traffic marking materials. Author

N71-33598# California Univ., Berkeley. Lawrence Radiation Lab.
**CRACK GROWTH MECHANISMS IN FIBROUS COMPOSITES**
William W. Gerberich (Ph.D. Thesis) Feb. 1971 114 p refs
(Contract W-7405-eng-48)
(UCRL-20524) Avail: NTIS

Aluminum alloy-matrix composites, unidirectionally reinforced with boron (brittle) and stainless steel (ductile) fibers were studied with respect to current ductile fracture hypotheses, the rule of mixtures for uniaxial tensile properties and some new concepts proposed for static and fatigue crack propagation behavior. Theoretical analyses of current ductile fracture concepts were reviewed and the relationship between strain energy release rate, crack-tip displacement and fracture strain concepts were developed. Considering composite fracture behavior, plastic strip models were derived for both longitudinal and transverse fracture. The critical geometrical factor in all cases is the volume of plastically-deforming material per unit fracture area which can be described as a function of volume fraction. It was found that both critical crack-tip displacement and critical fracture strain criteria could describe ductile fracture in metal-matrix composites reinforced with ductile fibers. Author

N71-33723# Office National d'Etudes et de Recherches Aerospatiales, Paris (France)
**FIBROUS COMPOSITE MATERIALS WITH A METALLIC MATRIX [MATERIAUX COMPOSITES FIBREUX A MATRICE METALLIQUE]**
Jean-Pierre Trottier (Ph.D. Thesis – Paris Univ.) 1970 45 p refs In FRENCH; ENGLISH summary
(ONERA-NT-170) Avail: NTIS

A bibliographic survey is presented on the properties and the manufacturing mode of these materials, and on the criteria for choosing the various component phases. The interaction between phases, during heat treatment of both a nickel-coated and uncoated beryllium wire within an aluminum matrix obtained by electrolysis, was studied by X-rays and with a scanning electron microscope. A study of the fibrous material obtained by unidirectional solidification of the aluminum-beryllium eutectic alloy was carried out by optical and electron microscopy, and also by X-ray diffraction. Based on X-ray diffraction and electron microscope crystallographic studies of the Cd-Cd3Cu eutectic alloy, and of Co, TaC-(Co,Cr), TaC-(Ni,cr), TaC fibrous composite alloys, obtained by unidirectional solidification, the growth directions were determined as well as the reciprocal orientation relations of the various phases. Author

N71-33740# Sandia Corp., Albuquerque, N.Mex. Technical Translation Service.
**EFFECT OF BORON ON CERTAIN PHYSICAL CHARACTERISTICS OF SYNTHETIC GRAPHITES**
A. S. Kotosonov et al Apr. 1971 12 p refs Transl. into ENGLISH from Khim. Tverd. Topl. (USSR), no. 3, 1970 p 115–120
Sponsored by AEC
(SC-T-713023) Avail: NTIS

The effects of boron on the plasticity and structure of the carbon component and on the strength and the electron properties of carbonaceous material produced by thermomechanical treatment (TMT) are discussed. It was established that the deformation of samples during thermochemical treatment and the density and mechanical strength of graphite are increased with elevation in boron content. The structure of borated graphite is characterized by large crystallite dimensions and a smaller interplanar spacing. The electron properties of graphite depend on the amount of boron dissolved in the lattice, replacing part of the carbon atoms. The maximum solubility of boron is limited to one weight percent with respect to the ordered part of the carbon. Author (NSA)

N71-33897# Council for Scientific and Industrial Research, Pretoria (South Africa). Foreign Language Information Service.
**TECHNIQUES FOR ANALYZING THE SIZE OF FINE PARTICLES [TECHNIQUES D'ANALYSE DIMENSIONELLE DE FINES PARTICULES]**
R. Denayer Feb. 1970 10 p Transl. into ENGLISH from J. Intl. de Chem. Anal., 16 Nov. 1967 p 173–175
(Ref-833) Avail: NTIS

Two methods for determining the size of fine particles are discussed. The Coulter Counter method determines the number and size of particles suspended in an electrically conducting fluid. The Joyce Centrifuge method analyzes paticles by application of Stokes laws to sedimentation acceleration. The importance of accurately determining the size of particles used in commercial products is discussed. Author

# 19 MATHEMATICS

Includes calculation methods and theory; and numerical analysis. For applications see specific categories. For related information see also: 08 Computers.

N71-32822# Joint Publications Research Service, Washington, D.C.
**DYNAMIC CONTROL AND STATISTICAL DECISIONS**
5 Aug. 1971 23 p refs Transl. into ENGLISH from Avtomatika, Akad. Nauk Ukr. RSR (Kiev), no. 1, 1971 p 5–9, 51–63
(JPRS-53766) Avail: NTIS

CONTENTS:
1. THEORY OF LOGIC-DYNAMIC CONTROL SYSTEMS K. D. Zhuk p 1–6 refs (See N71-32823 20-19)
2. MULTILAYER THEORY OF STATISTICAL DECISIONS A. G. Ivakhenko et al p 7–22 refs (See N71-32824 20-19)

N71-32823# Joint Publications Research Service, Washington, D.C.
**THEORY OF LOGIC-DYNAMIC CONTROL SYSTEMS**
K. D. Zhuk *In its* Dyn. Control and Statist. Decisions 5 Aug. 1971 p 1–6 refs (See N71-32822 20-19)
Avail: NTIS

It is shown that in modeling logic-dynamic control systems, logic-differential equations can be used to investigate such systems, and discrete programming techniques can be used as optimization methods. An aggregate of logic-operator matrices and a corresponding system of logical functions are presented which formally represent the law of logic-dynamic control systems. D.L.G.

N71-32824# Joint Publications Research Service, Washington, D.C.
**MULTILAYER THEORY OF STATISTICAL DECISIONS**
A. G. Ivakhenko et al *In its* Dyn. Control and Statist. Decisions 5 Aug. 1971 p 7-22 refs (See N71-32822 20-19)
Avail: NTIS

Statistical decision theory is treated in accordance with the basic idea of the method of data handling by groups. A one-layer algorithm is replaced by several partial algorithms, composed for the most highly possible pairs of arguments, with automatic threshold selections of the best combinations. With an increase in the number of selection layers, accuracy of decision is increased until a maximum is reached, thus making it possible to find an optimum complexity multilayer decision algorithm. The structuring of this algorithm is demonstrated. D.L.G.

N71-32877# Joint Publications Research Service, Washington, D.C.
**OPERATIONS RESEARCH**
Yu. P. Ivanilov, ed. 28 Jul. 1971 104 p refs Transl. into ENGLISH from the book "Issledovaniye Operatsiy (Modeli, Sistemy, Resheniya)" Moscow, Izd. Akad. Nauk SSSR, no. 1, 1970 p 58-159
(JPRS-53701) Avail: NTIS

CONTENTS:

1. DIFFERENTIAL GAMES WITH TERMINAL PAYOFF M. S. Nikolskiy p 1-13 refs (See N71-32878 20-19)
2. GENERALIZATION OF THE M. DRESHER PROBLEM A. F. Smolyakov p 14-32 refs (See N71-32879 20-19)
3. GENERALIZED DIFFERENTIAL GAMES E. R. Smolyakov p 33-45 refs (See N71-32880 20-19)
4. MINIMAX PRINCIPLES IN DIFFERENTIAL GAMES A. I. Propoy p 46-55 refs (See N71-32881 20-19)
5. COMBINED INFORMATION-DIAGNOSTIC PROGRAM V. P. Cherenin et al p 56-69 refs (See N71-32882 20-19)
6. ARRANGEMENT OF WAREHOUSES CONSIDERING LOSSES V. P. Cherenin p 70-102 refs (See N71-32883 20-19)

N71-32878# Joint Publications Research Service, Washington, D.C.
**DIFFERENTIAL GAMES WITH TERMINAL PAYOFF**
M. S. Nikolskiy *In its* Operations Res. 28 Jul. 1971 p 1-13 refs (See N71-32877 20-19)
Avail: NTIS

The quality problem is defined using a vector derivative of z where z belongs to an n-dimensional Euclean space and the control vectors are compactums. The guaranteed estimates, basic assumptions, and construction of the optimal guaranteed estimate are discussed. For those cases in which the construction of the guaranteed estimate is ineffective, a method is developed using the alternating Pontryagin integral to obtain a guaranteed estimate with a linear differential game. N.E.N.

N71-32879# Joint Publications Research Service, Washington, D.C.
**GENERALIZATION OF THE M. DRESHER PROBLEM**
A. F. Smolyakov *In its* Operations Res. 28 Jul. 1971 p 14-32 refs (See N71-32877 20-19)
Avail: NTIS

A study is made of the problem of selecting objects for attack and defense in a strategic game with one attacker and several defenders. The attacking strategy is to select one target for attack, and the defending strategies are to select several targets from the total number which will be defended by one defense unit each. The problem is then extended to a game for several attackers and several defenders. N.E.N.

N71-32880# Joint Publications Research Service, Washington, D.C.
**GENERALIZED DIFFERENTIAL GAMES**
E. R. Smolyakov *In its* Operations Res. 28 Jul. 1971 p 33-45 refs (See N71-32877 20-19)
Avail: NTIS

The problem concerns an n-dimensional Euclidean space in which the movement of a particle is defined by a system of equations in y, u, v, and t, where u and v are elements of closed sets U and V, respectively. At each point in time t, the first player selects u out of U so as to insure a minimum of a functional I. The second player then selects v from V, striving to maximize I. The discussion is limited to functions f(y, u, v, t), bounded and continuous with respect to y, u, v, and continuously differentiable with respect to each of the variables. The necessary conditions of weak and very weak extremum, and of strong extremum are delineated. N.E.N.

N71-32881# Joint Publications Research Service, Washington, D.C.
**MINIMAX PRINCIPLES IN DIFFERENTIAL GAMES**
A. I. Propoy *In its* Operations Res. 28 Jul. 1971 p 46-55 refs (See N71-32877 20-19)
Avail: NTIS

The conditions of optimality for differential games are obtained for the case where the saddle point cannot exist. A two-player game is described by a differential equation in which the first derivative of t is a function f(x(t), u(t), v(t)), where x(t) is the state of the game, and u(t) and v(t) are the control inputs of the first and second players, respectively, at time t. The quality of the game is estimated by a functional I. The instantaneous values of x(t) and u(t) are known at each point in time to the second player, and x(t) is known to the first. It is necessary to find the function u(t, x) insuring the first player the best value of the functional I under the condition that the second player selects the worst function v(t, x, u) for the first player. N.E.N.

N71-32882# Joint Publications Research Service, Washington, D.C.
**COMBINED INFORMATION-DIAGNOSTIC PROGRAM**
V. P. Cherenin et al *In its* Operations Res. 28 Jul. 1971 p 56-69 refs (See N71-32877 20-19)
Avail: NTIS

A direct, computerized method by pattern recognition is described for retrieving information on disease histories for diagnostic purposes. The disease histories are considered as objects and the diagnoses as classes. The difficulties connected with determining the probabilities of a disease in the presence of a given set of symptoms or with constructing interfaces are eliminated. However, the problem of experimentally establishing the similarity criterion as a function of the size of the file of known objects arises. When comparing each disease history with the interrogation, it is possible to consider the significance of the symptoms. Both disease histories and their frequencies are generated for each interrogation. The initial information input, information about interrogations, and preliminary and final diagnostic output are described, and examples are given. N.E.N.

N71-32883# Joint Publications Research Service, Washington, D.C.
**ARRANGEMENT OF WAREHOUSES CONSIDERING LOSSES**
V. P. Cherenin *In its* Operations Res. 28 Jul. 1971 p 70-102 refs (See N71-32877 20-19)
Avail: NTIS

The warehouse problem considers of the number of possible locations, the possible types of warehouses, and the volume of the

product stored. The function describing the problem includes the constant cost of the unit product, cost of storing the product for a given time, and the cost of warehouse construction and maintenance for a given time. External effects, such as cold, heat, atmospheric precipitation, insects, and rodents, on the stored products are characterized. The total uniformly distributed effect with respect to the entire region of distribution of the warehouses, the uniformly distributed effect with respect to territory only of the warehouses themselves, and the most unfavorable effect leading to maximum losses are described. Restrictions concerning the minimum volume stored and transportation of the product to consumption points are also discussed. N.E.N.

**N71-32946#** Academy of Sciences (USSR), Moscow. Inst. of Cosmic Research.
**COMBINATORIAL CODING FOR A DISCRETE STATIONARY SOURCE**
Yu. M. Shtarkov and B. F. Babkin 1971 26 p refs In RUSSIAN
Avail: NTIS

A method of nonuniform coding is proposed. The aggregate message is broken down by interlaced classes. Prefixed codes are utilized for the description of the classes, and the message within each of the classes. The fully coded message combination is formed by a successive entry of a class of coded combinations, and a message within the class. Transl. by J.M.C.

**N71-32948#** Academy of Sciences (USSR), Moscow. Inst. of Cosmic Research.
**AN A POSTERIORI ALGORITHM FOR FILTRATION OF MIXING PARAMETERS**
G. A. Mersov 1971 31 p refs In RUSSIAN
Avail: NTIS

The estimation of the size dimensions of navigational parameters is examined: those with linear dependence on navigation, and also those that are not directly related. In the case when the calculated parametric dimensions differ from the actual dimensions the estimation of the navigational parameters can be distorted. The dimensions of these deviations are called mixing parameters. The elimination of distorted estimates can be accomplished by the joint estimation of navigational and mixing parameters. If some mixing parameters are equal to zero, then the estimation of all mixing parameters cannot be carried out. An algorithm is presented which best allows the choice of mixing parameters which facilitate the estimation. Transl. by J.M.C.

**N71-32963#** Nihon Univ., Tokyo (Japan). Atomic Energy Research Inst.
**ON ORIGIN AND PHYSICAL MEANING OF WARD-LIKE IDENTITY IN DUAL-RESONANCE MODEL**
Osamu Hara 1971 20 p refs
(NUP-A-71-5) Avail: NTIS

It is shown for the string model that the Ward-like identities in the dual-resonance model follow directly from a requirement that the theory must be covariant under arbitrary transformation of the Lagrange coordinate labeling each constituent part of the string. Thus, at least for the string model, these identities are a necessary consequence of a general principle to be satisfied by any consistent physical theory. The discussion is restricted to the case alpha(0) = 1, and intercept one. Author

**N71-32970#** Istituto Superiore di Sanita, Rome (Italy). Lab. di Fisica.
**INTRODUCTION TO BOOLEAN ALGEBRA AND ITS APPLICATION FIELDS [INTRODUZIONE ALL'ALGEBRA DI BOOLE CON RIFERIMENTO AI SUOI CAMPI DI APPLICAZIONE]**
R. Biancastelli 20 Jul. 1970 50 p In ITALIAN; ENGLISH summary
(ISS-70/18) Avail: NTIS

The fundamentals of Boolean algebra are presented for students and technicians interested in its applications in digital electronics and relay networks. The principles are explained and a solution for a complicated problem is included as an example. The construction of a matrix for the conversion of a digital BCD-coded number into telex-code is shown. Author

**N71-32985#** Iowa Univ., Iowa City. Dept. of Mathematics.
**A NONLINEAR BOUNDARY VALUE PROBLEM OF STURM-LIOUVILLE TYPE FOR A TWO DIMENSIONAL SYSTEM OF ORDINARY DIFFERENTIAL EQUATIONS**
Paul Waltman and Jack W. Macki (Alberta Univ., Calgary) Jul. 1970 22 p refs Sponsored in part by Natl. Res. Council of Can.
(Contract DAAF03-69-C-0014; Proj. Themis)
(AD-724175; THEMIS-UI-TR-20) Avail: NTIS CSCL 12/1

In this report the authors consider the boundary value problem P sub lambda: x = f(t,x,y,lambda), y = g(t,x,y,lambda), A sub 1 y(a) + A sub 2 y(a) = 0, B sub 1 y(b) + B sub 2 y(b) = 0. x(t) and y(t) are scalar functions for t epsilon (a,b), (A sub 1)squared + (A sub 2)squared > zero, (B sub 1)squared + (B sub 2)squared > zero. Values of the parameter lambda (eigenvalues) are sought for which there exists a nontrivial solution of P sub lambda. Two existence theorems are established and these are applied in several situations previously studied. In particular, one theorem applies to a model of a nonlinear vibrating string. Author (GRA)

**N71-32989#** Forsvarets Forskningsanstalt, Stockholm (Sweden).
**ON THE CALCULATION OF FOURIER INTEGRALS**
Bo Einarsson Dec. 1970 23 p refs Presented at the Scand. Computer Congr. NordDATA, Copenhagen, 26-28 Aug. 1970
(FOA-2-C-2446) Avail: NTIS

A comparison between the Filon formula and a spline method for calculating Fourier integrals ws given. The comparison shows that the spline method is superior in that it gives higher accuracy for the same number of function evaluations. The spline algorithm is given in the appendix. Author (ESRO)

**N71-33010#** Research Inst. of National Defence, Stockholm (Sweden).
**NUMERICAL SOLUTION OF ABEL'S INTEGRAL EQUATION WITH SPLINE FUNCTIONS**
Bo Einarsson Feb. 1971 24 p refs Presented at the Scand. Computer Congr. NordDATA, Copenhagen, 26-28 Aug. 1970 Sponsored in part by Roy. Inst. of Technol.
(FOA-2-C-2455) Avail: NTIS

An Abelian integral equation, based on the physical problem of X-ray radiation intensity after passage and absorption through an object with cylinder symmetry, is numerically solved with spline functions in several ways. Three possibilities of numerical solution are discussed: a direct method, an indirect method, and a least squares method, the last method appearing to be the best. ESRO

**N71-33111#** Rome Univ. (Italy). Inst. of Physics.
**ON A SEMIGROUP APPROACH TO QUANTUM FIELD EQUATIONS**
E. Salusti and A. Tesei 15 Sep. 1970 30 p refs *Its* Nota Interna No. 285
Avail: NTIS

Some field equations, suggested by the Thirring and Federbush models in quantum field theory are studied in a two dimensional space-time. The theory of nonlinear semigroup is used. The unknown are functions whose values are bounded operators on a Hilbert space. The existence and unicity of the global solution is proved. Author (ESRO)

N71-33131# RAND Corp., Santa Monica, Calif.
**ON THE LIMITATIONS OF QUANTITATIVE ANALYSIS**
E. S. Quade Dec. 1970 24 p refs Presented at the 137th Meeting of the American Association for the Advancement of Science, Chicago, 26 Dec. 1970
(P-4530) Avail: NTIS

An evaluation of the usefulness of quantitative analyses is presented with respect to problems of public affairs and government decision making. It is felt that analysis is completely quantified if the problem can be described purely on the basis of the results obtained from the model, but that such situations are usually not found in the domain of public policy. Internal limitations also exist in the ultimate reduction of quantitative analysis to a sequence of judgments. Much progress has been made in recent years, however, toward overcoming methodological difficulties and in applying this type of analysis to a larger subject area. Nonetheless, when considering its use, it is necessary to carefully ascertain its suitability for the problem at hand. Where applicable, relevant information on performance and costs can be obtained. The method also often counters the subjective approach on the part of advocates of a program and may force them to change their line of argument to consider realities, rather than merely expressing their personal opinions. A.C.R.

N71-33133# RAND Corp., Santa Monica, Calif.
**SOLUTION OF THE THOMAS FERMI MODEL WITH QUANTUM CORRECTIONS**
James E. Enstrom Feb. 1971 17 p refs
(P-4546) Avail: NTIS

A new and more accurate numerical solution was obtained to the differential equation which determines the first-order quantum mechanical corrections to the Thomas-Fermi model of the atom. When used to calculate the diamagnetic susceptibility and atomic polarizability of the inert gases, it leads to a substantial improvement over the Thomas-Fermi model alone, and hence lends support to the validity of the quantum mechanical corrections. Author

N71-33144# Royal Inst. of Tech., Stockholm (Sweden). Dept. of Information Processing.
**NUMERICAL TREATMENT OF INTEGRO-DIFFERENTIAL EQUATIONS WITH A CERTAIN MAXIMUM PROPERTY**
Bo Einarsson (Res. Inst. of Naval Defense) 1970 52 p refs
(Rept-NA-70-19) Avail: NTIS

The solving is studied of an initial value problem of integro-differential type, where the differentiation is made for the time variable and the integration for the space variable. The problem, based on the creep analysis of thick walled shells, has a property C, which implies that the solution is decreasing at the maximum points. ESRO

N71-33203# RAND Corp., Santa Monica, Calif.
**MINIMAL SCRAMBLING SETS OF SIMPLE ORDERS**
Joel Spencer Jan. 1971 13 p refs
(P-4555) Avail: NTIS

Let $2 < or = k < n$ be fixed integers. A family F of simple orders on an n element set is said to be k-suitable if of every k elements in the n set, each one is the largest of the k in some simple order in F. Bounds are found on the minimal size of such an F. F is said to be $k^*$-suitable if for every k elements in the n-set each permutation of the k elements is realized in some simple order in F. Again bounds are found on the minimal size of such an F. Author

N71-33280# Paris Univ. (France).
**RELATIONSHIPS BETWEEN EXPERIMENTAL SURFACES**
Daniel Bendist (Ph.D. Thesis) 15 Apr. 1970 227 p refs In FRENCH
(AD-4193) Avail: NTIS

Considered are variance and matrix methods for analyses of orthogonal surfaces and construction of multifactor surface geometries, rectangular surfaces, and mixed surfaces of bound composites. Example calculations for a cement-oil interface, a water-oil interface, and an oil-oxidation interface are included. Transl. by G.G.

N71-33383# Laboratoire de Physique Theorique et des Hautes Energies, Orsay (France).
**GENERALIZATIONS OF DUAL MODELS**
J. L. Gervais and B. Sakita May 1971 32 p refs
(LPTHE-71/23) Avail: NTIS

Generalizations of the dual model for resonance amplitudes are discussed in the context of functional integral formulation of the theory. It is shown that from every field theory which is two-dimensional, local, and conformally invariant, a dual model can be deduced. An advantage of this approach is that the problem of generalization can be essentially discussed in terms of the Lagrangian density whose symmetry determines the properties of the dual amplitudes. Only conformal spin zero and conformal spin 1/2 fields can be introduced in a simple way, however. A.C.R.

N71-33385+ Toulouse Univ. (France).
**CONTRIBUTION TO THE SYNTHESIS OF LOGICAL FUNCTIONS WITH THRESHOLD ELEMENTS**
P. Azema (Ph.D. Thesis) 15 Dec. 1970 140 p refs In FRENCH
Avail: NTIS

Logic circuit optimization analyses are performed by systematic decomposition of the logical function F sub o through linearized separation. A matrix limitation method is used to obtain the summability and vector characteristics of threshold functions. Two essential decomposition methods for logical functions into subfunctions for the synthesis of threshold elements are described. Transl. by G.G.

N71-33415# Maryland Univ., College Park. Computer Science Center.
**ORDERED SEARCH TECHNIQUES IN TEMPLATE MATCHING**
Roger Nagel and Azriel Rosenfeld Aug. 1971 21 p
(Grant NSF GJ-754)
(TR-166) Avail: NTIS

Ordering schemes were studied to make digital template matching more efficient by selecting the order in which template points are compared to the corresponding picture points (in a given position of the template on the picture) in an arbitrary (e.g., raster) order. Two ordering schemes were tested; both yielded improved matching efficiency. Author

N71-33429*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
**REDUNDANCY OPTIMIZATION FOR SERIES K-OUT-OF-N SYSTEMS**
Darl D. Bien [1971] 15 p refs Presented at the 131st Ann. Meeting of the Am. Statist. Assoc., the Biometric Soc., and the Inst. of Math. Statistics, Ft. Collins, Colo., 23-26 Aug. 1971
(NASA-TM-X-67910) Avail: NTIS CSCL 12A

The optimum allocation of redundancy in a system of serially connected subsystems in which each subsystem is of the k-out-of-n type was considered. The two problems treated were (a) maximization of system reliability subject to multiple cost constraints and (b) minimization of some function of multiple costs while maintaining at least a minimum acceptable level of reliability. Five techniques were presented for solving one or both of these problems. Since the choice of solution technique is determined by

such things as computer program availability, degree of accuracy needed, and extent of desired optimum surface mapping, the relative merits of these techniques were discussed. The series-parallel redundancy optimization problem is a special case of the problem treated here. For this case, approximate solutions in closed form were presented. These solutions were compared with solutions produced by a method of exact optimization. Author

N71-33493*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
**MOD 2 SEQUENTIAL FUNCTION GENERATOR FOR MULTIBIT BINARY SEQUENCE Patent Application**
Tage O. Anderson, inventor (to NASA) 19 p 1 Oct. 1970
(Contract NAS7-100)
(NASA-Case-NPO-10636; US-Patent-Appl-SN-77221) Avail: NTIS CSCL 12A

A simple modular-type MOD 2 sequential function generator capable of providing a multibit binary sequence is described. The basic system comprises 2-bit shift register 21 and 22, one register for each pair of bits in the sequence. The false output of each register serves as its true input. The input and output stages of each register are initially loaded to 1 and 0 states, respectively. Each register, succeeding the first register, is clocked at one-fourth the clocking rate of the preceding register. The true outputs of the registers are MOD 2 added by 23 to provide the generator's output. The basic advantage of the system is its simplicity, reduced number of elements, and the modular construction which accounts for reduced manufacturing costs. NASA

N71-33529*# Stanford Univ., Calif. Inst. for Plasma Research.
**INTERPRETATION OF DISPERSION RELATIONS FOR BOUNDED SYSTEMS**
T. D. Rognlien and S. A. Self May 1971 68 p refs
(Grant NGL-05-020-176)
(NASA-CR-121435; SU-IPR-423) Avail: NTIS CSCL 12A

A treatment is given of the problem of constructing normal modes for an arbitrarily bounded system from roots of the linear dispersion relation for the corresponding infinite or periodically bounded system. For a system described by continuous macroscopic variables, and of general cylindrical form (uniform along an axis z, say), each transverse eigenmode gives rise to a set of axial normal modes constructed from a pair of dominant roots satisfying the boundary conditions which are characterized by complex reflection coefficients for the dominant waves. The implications of the results for the interpretation of experiments on plasma waves and instabilities on finite cylinders is discussed, with particular reference to the effects of end plate damping and axial current on Q machines. Author

N71-33534# Imperial Coll. of Science and Technology, London (England). Dept. of Mechanical Engineering.
**A NOVEL FINITE-DIFFERENCE FORMULATION FOR DIFFERENTIAL EXPRESSIONS INVOLVING BOTH FIRST AND SECOND DERIVATIVES**
D. B. Spaulding Nov. 1970 20 p refs
(EF-TN-A-38) Avail: NTIS

It is shown that the upwind-difference scheme of formulating differential expressions, in problems involving transport by simultaneous convection and diffusion, is superior to the central-difference scheme, when the local Peclet number of the grid is large. Even better schemes are derived and discussed. It is pointed out that the best finite-difference analogs are found by approximating differential expressions as a whole, and that simple (e.g. one-dimensional) exact solutions form a useful, legitimate, and independent source of these optimum algebraic formulas. Author

N71-33554*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
**OPTIMAL DESIGN PROCEDURES FOR TWO-LEVEL FRACTIONAL FACTORIAL EXPERIMENTS GIVEN PARTIAL PRIOR INFORMATION ABOUT PARAMETERS**
Steven M. Sidik and Arthur G. Holms [1971] 13 p refs
Presented at the 131st Ann. Meeting of the Am. Statist. Assoc. in Conjunction with the Allied Social Sci. Assoc., Ft. Collins, Colo., 23–26 Aug. 1971
(NASA-TM-X-67901) Avail: NTIS CSCL 12A

Prior information should be incorporated into the design of further experiments. Assumed is that such information is expressed in probabilities is that each parameter of the full factorial model is nonzero. Developed is an optimal design procedures by posing the experimental design problem as a finite decision problem. Bayes and mini-max design strategies are then derived and their applications illustrated. The major computational step is the evaluation of all possible matchings of physical variables to the abstract variables of all potential designs. The technique of telescoping sequences of blocks permits the consideration of experiments to be performed in stages. Author

N71-33580# Joint Publications Research Service, Washington, D.C.
**GAME APPROACH TO PROBLEM OF CONTROLLING DESCENT OF COSMIC APPARATUS IN ATMOSPHERE. 1**
G. M. Zuyev et al 17 Aug. 1971 15 p refs Transl. into ENGLISH from Avtomat. Telemekh. (Moscow), No. 2, 1971 p 5–14
(JPRS-53839) Avail: NTIS CSCL 12A

The game approach is applied to the problem of controlling the descent of a cosmic apparatus moving with a velocity close to the second cosmic velocity. The initial problem is reduced to two model problems, for which the optimal strategies of behavior and disturbance were constructed, the value of the game was determined, and the optimal control algorithms were obtained. Author

N71-33676 Michigan State Univ., East Lansing.
**A COMPARISON OF FINITE ELEMENT AND FINITE DIFFERENCE METHODS IN ELASTOSTATIC PROBLEMS**
Nicholas P. Dario (Ph.D. Thesis) 1969 308 p
Avail: Univ. Microfilms Order No. 70-15014

Finite element stiffness matrices were derived for plane and axially symmetric problems. Both constant and linearly varying strain triangles were considered. Nodal point forces associated with boundary tractions were treated in detail. Finite difference expressions associated with the Navier elasticity equations were derived in a more general form which allows consideration of anisotropic materials. The comparison of the methods was given in terms of specific applications. Both plane stress and axially symmetric examples were included. In each category, a problem with a well known elasticity solution was treated so that comparisons could also be made with the so called exact solution. An application involving a simple composite body was also presented. The investigation demonstrates the ability of the finite element and finite difference methods to give equally good results in displacement analysis. Agreement with elasticity solutions was excellent for each method. Dissert. Abstr.

N71-33677 Columbia Univ., New York.
**NUMERICAL SOLUTION OF THE LINEAR INTEGRAL BOLTZMANN EQUATION**
Dermott Edward Cullen (Ph.D. Thesis) 1969 364 p
Avail: Univ. Microfilms Order No. 70-16998

The linear integral Boltzmann equation as applied to neutron and photon transport problems normally encountered in reactor core and shield design was investigated. The multi-group approximation was introduced to reduce the energy dependent Boltzmann equation to a set of coupled group averaged equations. This course was taken to parallel the treatment of the energy variable by existing

techniques and to focus attention on the treatment of the angular variable. The original problem was then demonstrated to be equivalent to a coupled set of integral equations in which the kernels may be physically related to a non-collision probability. The kernels for the integral equations were studied in detail for the special case of plane and spherical geometries. The kernels were used to obtain numerical solutions to critical and source problems in plane and spherical geometries. Dissert. Abstr.

**N71-33728#** Montpellier Univ. (France).
**COMPARATIVE EVOLUTION OF THE INVERSE PROBLEMS**
Pierre C. Sabatier 1971 57 p refs Presented at Workshop on the Mathematics of Profile Inversion, Moffett Field, Calif., 12-16 Jul. 1971
(PM/71/4) Avail: NTIS

The only way of extracting from the experimental results the total amount of information they may contain is to solve inverse problems. The first goal of a physicist, when a new study is undertaken, is to obtain satisfactory fits. This can be done either by approximate methods, or by numerical computations. However, it becomes rapidly obvious that good fits can be obtained which correspond eventually to fairly different informations on the unknown quantities. The progressive realization of the consequences of this nonuniqueness imply an evolution both of the methods and of the centers of interst in the inverse problems. This evolution is schematically described together with the various mathematical methods which are used. This permits comparative descriptions of the inverse methods in scientific research, with examples taken as well in mathematics, quantum and classical physics, seismology, transport theory, radiative transfer, electromagnetic scattering, seismology, transport theory, radiative transfer, electromagnetic scattering, electrocardiology, etc. It is hoped that this paves the way for an interdisciplinary study of the inverse problems, leading eventually to design of experiments which are the most efficient to give information. Author

**N71-33759#** Office National d'Etudes et de Recherches Aerospatiales, Paris (France).
**IMAGE ANALYSIS BY MULTIPLEX CODING [ANALYSE D'IMAGE ET CODAGE MULTIPLEX]**
Andre Girard 1971 15 p refs In FRENCH; ENGLISH summary Presented at the Reunion AGARD Sur Les Limitations De Propagation Dans La Detection A Distance, Colorado Springs, Colo., 21-25 Jun. 1971
(TP-972) Avail: NTIS

Trigonometric functions and binary functions were used as the bases for sets of orthogonal functions including Fourier and Fresnel transform; in the first image analysis case; and Walsh-Hadamard transform, pseudo-random codes in the second case. The case of an incoherent radiation distribution was analyzed by means of a system whose radiation transducer was a flux detector receiving incoming signals in a coded form. The coding presents the characters of a multiplex method; it ensures the optimum use of the available time to analyze the distribution under study, as the flux detector receives during the whole analysis time the radiation issued from all the elements of the space function. A gain on the signal/noise ratio may thus be obtained as compared to direct analysis methods. The spectral range considered is in the infrared region. Author

**N71-33883#** National Research Council of Canada, Ottawa (Ontario). Div. of Mechanical Engineering.
**A REVIEW OF THE POLE ASSIGNMENT PROBLEM FOR MULTIVARIABLE SYSTEMS**
I. H. Mufti May 1971 42 p refs
(NRC-ME-MK-28; NRC-12071) Avail: NTIS

The problem of pole assignment in linear time-invariant multivariable systems is reviewed. The case when all the states are available for measurement is considered first and a procedure is given to construct a feedback matrix that produces the required closed-loop poles. The construction of state estimators using both the Kalman filter theory and the Luenberger observer theory are explained for the case in which all the states are not accessible for measurement. The compensation procedure for arbitrary pole assignment in the closed-loop system consisting of the given system and the compensator is discussed. Author

**N71-33896*#** Texas Univ., Dallas.
**EQUATIONS OF MOTION IN THE LINEAR APPROXIMATION**
Ivor Robinson and Joanna R. Robinson [1971] 29 p refs
(Grants NGL-44-004-001; AF-AFOSR-903-67)
(NASA-CR-121431) Avail: NTIS CSCL 12A

A technique, using the field approach, is described for investigating the motion of singularities. Advantages of approaching linear approximation for general relativity, and the approach used to develop a gauge invariant theory of singularities are given. E.H.W.

**N71-33903#** Laboratoire de Physique Theorique et des Hautes Energies, Orsay (France).
**MULTIPOLE FREE DUAL AMPLITUDES WITH MANDELSTAM ANALYTICITY**
L. Gonzalez Mestres May 1971 11 p refs
(LPTHE-71/26) Avail: NTIS CSCL 12A

Alternatives to multipoles are presented in the recently proposed Mandelstam analytic dual amplitudes. The general properties and possible implications of the new formula are briefly discussed. Author

**N71-33922#** Northeastern Univ., Boston, Mass. Dept. of Physics.
**BROKEN SCALE INVARIANCE, CURRENT ALGEBRA, AND MASSIVE GRAVITATION. 1: GENERAL FORMULATION**
P. Nath, R. Arnowitt, and M. H. Friedman Jul. 1971 45 p refs Sponsored in part by NSF
(NUB-2091) Avail: NTIS

A general formalism was constructed to describe meson interactions at intermediate energies and below obeying the conditions of broken scale invariance and chiral current algebra. In the procedure one dominates the I = 1 vector current by the rho meson, the I = 1 axial current by the A sub 1 and pi mesons, the divergence of the axial current by the pi meson, etc. S-matrix elements were then reduced to calculating a specific set of tree and seagull diagrams. The technique has been applied to a wide variety of phenomen with considerable success. The scale breaking condition was postulated by using the trace of the Belinfante stress tensor as the source of the sigma meson. Author

**N71-33958#** Laboratoire de Physique Theorique et des Hautes Energies, Orsay (France).
**GALILEAN INVARIANCE IN THE INFINITE MOMENTUM FRAME AND THE PARTON MODEL**
Cl. Bouchiat, P. Fayet, and Ph. Meyer May 1971 37 p refs
(LPTHE-71/24) Avail: NTIS

Field theory in the infinite momentum frame variables was used to derive the parton model, and to stress the implications of transverse Galilean and longitudinal Lorentz boost invariances. The elastic nucleon electromagnetic form factor and inelastic structure functions were expressed as density and correlation functions for partons in the transverse plane, in direct analogy with expressions of nonrelativistic atomic physics. A connection was established between the transverse momentum cutoff and the q squared dependence of the electromagnetic elastic form factor. The scaling

law for the parton model was derived under conditions which appear in a rather transparent way. The corresponding sum rules were studied. A generalization of the Bjorken-Feynman scaling was obtained in the nonforward Compton scattering amplitude relevant to the two photon correction in very high energy electron-nucleon elastic scattering. Author

**N71-33962*+** Rensselaer Polytechnic Inst., Troy, N.Y.
**IMPROVED COMPUTATIONAL METHODS FOR INITIAL STATE AVERAGING, VOLUME 3 Final Report, 4 Nov. 1969–4 Apr. 1971**
Derek E. McBrinn 1971 41 p refs
(Contract NAS8-21131)
(NASA-CR-119913) Avail: NTIS CSCL 12A

A computational algorithm has been derived to mechanize the theory of optimal time-invariant output-feedback controllers previously developed. The new algorithm uses the techniques of numerical integration. It is computationally much faster than the original analytic algorithm, and allows its economic use on systems of higher order. For Vol. 2, see: N71-28160. Author

**N71-33963*+** Rensselaer Polytechnic Inst., Troy, N.Y.
**USER'S GUIDE FOR COMPUTER PROGRAM COMPDES, VOLUME 4 Final Report, 4 Nov. 1969–4 Apr. 1971**
Lutz Willner 1971 17 p refs
(Contract NAS8-21131)
(NASA-CR-119912) Avail: NTIS CSCL 12A

The purpose of the compensator design program (COMPDES) is the design of a low order compensator to stabilize a given controllable and observable linear time invariant system in the presence of parameter uncertainties. The program can be broken down into two major sections. The first section consists of a gradient procedure which tries to increase the stability of a system by computing appropriate feedback gains, and the second section carries out the actual compensator design and sensitivity reduction. Author

# 20 METEOROLOGY

Includes climatology; weather forecasting; and visibility studies. For related information see also: 13 Geophysics; and 30 Space Sciences.

**N71-32803#** Air Force Cambridge Research Labs., Bedford, Mass.
**ON THE EFFECT OF HEAT OF PHASE TRANSFORMATIONS ON THE RATE OF DIFFUSION PROCESSES IN DROP CLOUDS**
B. Sh. Beritashvili et al 7 Apr. 1971 19 p refs Transl. into ENGLISH from Tr. Zakavkazskii Nauchn.-Issled. Gidrometeorol. Inst., Tiflis (USSR), v. 21, no. 27, 1967 p 35–44
(AD-724105; AFCRL-71-0278; AFCRL-Trans-92) Avail: NTIS CSCL 4/2

On the basis of simultaneous solution of equations of diffusion growth and thermal balance of a drop, a formula is given for calculating the rate of its condensation growth and evaporation taking into account the emission of latent heat of condensation, the curvature of the drop surface and the mass of matter dissolved in it. Formulae introduced earlier by other authors are particular cases of the obtained expression. The analysis of the given formula allows one to evaluate the optimum sizes of particles of certain salts which influence drop clouds. Author (GRA)

**N71-32806** World Meteorological Organization, Geneva (Switzerland).
**REQUIREMENTS FOR MARINE METEOROLOGICAL SERVICES**
1971 27 p *Its* Marine Sci. Affairs Rept. No. 4
(WMO-288) Copyright. Avail: Issuing Activity

Requirements for an international service for providing marine, meteorological, and subsurface information are detailed. ESRO

**N71-32889#** Atmospheric Sciences Lab., White Sands Missile Range, N. Mex.
**EVIDENCE FOR SULFATE AS A MAJOR CONDENSATION NUCLEUS CONSTITUENT IN NONURBAN FOG**
Gayle S. Rinehart Mar. 1971 33 p refs
(AD-724610; ECOM-5366) Avail: NTIS CSCL 4/2

To learn more about potential fog condensation nuclei content, 71 Anderson sampler particulate samples from the White Sands Missile Range, New Mexico area were examined. During a portion of the sampling period, from September to December, 1969, the Royco light scattering counter was employed simultaneously. Sulfates appeared to account for most of the soluble and thus potential condensation nuclei. Moisture was an important positive influence on the number of these particles; wind speed decreased their number. In general, the number of large and giant particles remained constant throughout the day. Daytime fluctuations were attributed to incursions of foreign air masses or to rain washout. It is concluded that the sulfate ion is sufficiently abundant in this and other nonurban areas to be a dominant constituent in cloud and fog condensation nuclei. Author (GRA)

**N71-32958** World Meteorological Organization, Geneva (Switzerland).
**MACHINE PROCESSING OF HYDROMETEOROLOGICAL DATA**
1971 91 p refs *Its* Tech. Note No. 115
(WMO-275) Copyright. Avail: Issuing Activity

The present state of the development and methods of analyzing hydrometeorological data in various countries by automatic machine processing is given. Emphasis is made on the use of computers when handling large amounts of information. ESRO

**N71-32960#** Williams Coll., Williamstown, Mass. Dept. of Geology.
**PROFILE OF A STORM: WIND, WAVES AND EROSION ON THE SOUTHEASTERN SHORE OF LAKE MICHIGAN**
William T. Fox and Richard A. Davis, Jr. 1970 9 p refs Prepared Jointly by Western Mich. Univ.
(Contract N00014-69-C-0151)
(AD-723932; TR-2) Avail: NTIS CSCL 4/2

A large low pressure system that passed through Lake Michigan during late July 1969, provided opportunity for detailed analysis of storm effects on beach and nearshore processes. During the passage of this storm, observations on 17 environmental parameters were being recorded at 2 hr intervals. These data were subjected to Fourier analysis and plotted in a time series by computer. Such analysis shows that there is a definite relationship between barometric pressure, breaker height, breaker angle and longshore current velocity. These are among the significant factors in beach erosion. As the storm passed, the beach and adjacent cliff underwent extensive erosion. The post-storm profile showed a nearshore sand bar which was derived from the beach area during the storm. During succeeding days, this bar began a shoreward migration and was eventually incorporated with the beach. Author (GRA)

**N71-32972#** Atmospheric Sciences Lab., White Sands Missile Range, N.Mex.
**DATA REDUCTION PROGRAM FOR ROCKETSONDE TEMPERATURES**
Bruce W. Kennedy, Elton P. Avara, and Bruce T. Miers Ft.

Monmouth, N.J. ECOM Mar. 1971 38 p refs
(AD-724599; ECOM-5367) Avail: NTIS CSCL 4/2

The paper describes a computer program that simplifies the reduction of temperature data from routine Meteorological Rocket Network instruments. The program is versatile enough to be used with standard and R and D sondes. Laboratory and flight tests related to temperature correction are described, and complete program and coding instructions are presented. Author (GRA)

N71-32976# Air Force Cambridge Research Labs., Bedford, Mass.
**ON THE THEORY OF ATMOSPHERIC DIFFUSION IN FOG CONDITIONS**
M. E. Berliand et al 25 Mar. 1971 21 p refs Transl. into ENGLISH from Tr. Gl. Geofiz. Observ. (Leningrad), no. 207, 1968 p 3–13
(AD-724104; AFCRL-71-0268; AFCRL-TRANS-91) Avail: NTIS CSCL 13/2

Study of cases of intense air pollution shows that a part of them is related to periods of extended fogs. The harmful effect of smoke and gaseous admixtures is revealed more sharply in fog than in other weather conditions: an unpleasant feeling from them is increased, the presence of admixtures in fogs furthermore decreases the visibility, etc. One notes a reverse effect when the presence of smoke contributes to the condensation of the atmospheric moisture. In this manner, a mutually increasing effect of smokes and fogs occurs. The report presents the estimates of the influence of river fogs (the theory of which is developed by Berliand and Onikul, on the distribution of gaseous admixtures. Author (GRA)

N71-32977# Air Weather Service, Scott AFB, Ill.
**PROCEEDINGS OF THE SIXTH AUTOMATED WEATHER SUPPORT TECHNICAL EXCHANGE CONFERENCE**
Mar. 1971 395 p refs Conf. held at Annapolis, 21–24 Sep. 1970
(AD-724093; AWS-TR-242) Avail: NTIS HC $6.00/MF $0.95 CSCL 4/2

The report contains the proceedings of the Sixth of the Technical Exchange Conferences sponsored by the Air Weather Service and hosted by one of the three armed services on a rotation basis. These sessions dealt with the following subject areas: Automated analysis and forecasting, Local area forecasting, Tailored meteorological support, Automated processing and application of satellite data, and Environmental simulation. The sixth and final session was devoted to a panel discussion on Automated meteorological support. GRA

N71-32980# Army Electronics Command, Fort Huachuca, Ariz. Atmospheric Sciences Lab.
**MICROMETEOROLOGICAL FIELD DATA FROM DAVIS, CALIFORNIA: 1966–1967 RUNS UNDER ADVECTION CONDITIONS**
Ernest B. Stenmark and Lorne D. Drury Aug. 1970 495 p refs
(AD-724812; ECOM-6052) Avail: NTIS CSCL 4/2

Micrometeorological data acquired during advection conditions in 1966 and 1967 at the University of California, Davis, field site are presented as 30-minute mean quantities in tabular form. Energy balance components and temperature and wind profiles are given in both tabular and plotted forms. Author (GRA)

N71-33000# Weather Wing (5th), Langley AFB, Va.
**FORECASTING AIR MASS THUNDERSTORMS AT NELLIS AFB, NEVADA**
Leonard D. McChesney 15 May 1971 14 p
(AD-724679; WWTN-71-2) Avail: NTIS CSCL 4/2

The paper describes an objective method for forecasting air mass thunderstorms at Nellis AFB, Nevada. It uses the Yucca Flats 1200Z ROAB data, and the average heating curves to arrive at the forecast. Author (GRA)

N71-33008# Finnish Meteorological Office, Helsinki.
**CLIMATOLOGICAL DATA FROM JOKIOINEN AND SODANKYLA OBSERVATORIES, 1969. METEOROLOGICAL YEARBOOK OF FINLAND, VOLUME 69, PART 1b [JOKIOISTENJA SODANKYLAN OBSERVATORIOIDEN ILMASTOHAVAINNOT, 1969. SUOMEN METEOROLOGINEN VUOSIKIRJA, NIDE 69, OSA 1 b, JULKAISSUT ILMATIETEEN LAITOS]**
1970 49 p refs In ENGLISH and FINNISH
(Rept-551-506-1-(480)) Avail: NTIS

The results of observations made by the meteorological observatories of Jokioinen and Sodankyla in 1969 are presented. The values obtained from recordings of atmospheric pressure and temperature; relative humidity; and wind direction and speed at even hours; are given as well as the amount of sunshine and cloud cover (including cloud formation and height); hydrometeors observed with time of appearance; visibility; and precipitation. Author

N71-33021# Chicago Univ., Ill. Lab. for Atmospheric Probing.
**DOPPLER RADAR CHARACTERISTICS OF PRECIPITATION AT VERTICAL INCIDENCE**
D. Atlas, R. C. Srivastava, and R. S. Sekhon 1 May 1971 69 p refs Prepared jointly with Ill. Inst. of Tech.
(Grants NSF GA-10639; NSF GA-27680X)
(LAP-TR-22) Avail: NTIS

A review and extension of the theoretical bases for measurement of rain and snow characteristics with vertically pointing Doppler radar are presented. The drop-size distribution in rain can be computed from the doppler spectrum provided the updraft can be estimated, but difficulties are involved in the case of snow. Doppler spectra and their moments are computed for rain using various power law relations of fallspeed vs. particle diameter and an exponential fit to the actual fallspeed data. These power laws, however, are useful approximations over only limited ranges of precipitation rate. Author

N71-33022# Chicago Univ., Ill. Lab. for Atmospheric Probing.
**ONE-DIMENSIONAL NUMERICAL SIMULATION OF A DUAL WAVELENGTH RADAR HAIL DETECTOR**
R. E. Carbone 1 Jun. 1971 46 p refs Prepared jointly with Ill. Inst. of Tech.
(Grants ESSA-E-22-14-71(G); NSF GA-19031)
(LAP-TR-24) Avail: NTIS

A detailed analysis of dual wavelength hail detector is performed, and four measurement schemes are investigated as to their relative effectiveness with respect to the various meteorological and radar parameters. It was found that background rainfall degrades hail detectability, but that proper choice of a measurement scheme ensures detection of average hail concentrations of 1 g m(−3) in background rainfall rates up to 100 mm hr(−1) without prior knowledge of the background. Hail wetness is shown to be of assistance to the detector and hail shafts with diameters as small as 0.25 km remain relatively uniformly detectable in the one-dimensional model. In addition, it is shown that simply reducing pulse length will not improve detectability and may in fact render hail less detectable due to the effect of signal fluctuations caused by inadequately averaged data. It is concluded that beam width effects in the two- and three-dimensional cases will, in all probability, be the factor that limits hail detectability rather than range resolution considerations. Generally, it was found that 1 micro-second electronics is adequate for the meteorological conditions considered provided the proper measurement scheme is chosen. Author

**N71-33075#** Aeronautical Chart and Information Center, St. Louis, Mo. Technical Library Section.
**STUDY OF THE NUTATIONAL MIGRATION OF THE ICELANDIC ATMOSPHERIC PRESSURE MINIMUM [K IZUCHENIYU NUTATSIONNOI MIGRATSII ISLANDSKOGO MINIMUMA ATMOSFERNOGO DAVLENIYA]**
I. V. Maksimov et al May 1971 13 p Transl. into ENGLISH from Probl. Arktiki i Antarktiki (USSR), no. 23, 1966 p 14-19
(AD-724501; ACIC-TC-1703) Avail: NTIS CSCL 4/2

The paper is a continuance of the investigation of the dependence of the depth of the Icelandic atmospheric pressure minimum and of the pressure gradients Madeira minus Stiksholm upon the wave of barometric polar flow. This is created in the earths atmosphere by free oscillations of the earths axis of rotation. The investigations were based on the mean coordinates of the center of the Icelandic atmospheric pressure minimum, computed by R. V. Abramov from the analysis of the average monthly atmospheric pressure charts in the northern hemisphere for the period from 1891 to 1962. The mean latitude of the location of this center of atmospheric activity was compared with the projection of the actual location of the earths pole of rotation upon the axis 0-180 deg (X sub sum). Author (GRA)

**N71-33146** World Meteorological Organization, Geneva (Switzerland).
**PROTECTION OF PLANTS AGAINST ADVERSE WEATHER**
G. W. Hurst and R. P. Rumney 1971 75 p refs *Its* Tech. Note No. 118
(WMO-281) Copyright. Avail: Issuing Activity

A survey on the methods and results of many papers published on protection of plants against meteorological extremes is presented. It is considered that types of protection such as greenhouses are outside the terms of reference, but that windbreaks and crop heating are admissible. The weather extremes included are temperature, sunlight, precipitation, and wind. The effects of these parameters are discussed and methods of protection against them given. An extensive, though not comprehensive, annotated bibliography is included. ESRO

**N71-33179#** Environmental Technical Applications Center (Air Force), Washington, D.C.
**DIURNAL VARIATION OF SUMMERTIME THUNDERSTORM ACTIVITY OVER THE UNITED STATES**
Eugene M. Rasmusson Apr. 1971 16 p refs
(AD-724645; USAFETAC-TN-71-4) Avail: NTIS CSCL 4/2

Observations from 294 Air Force and National Weather Service Stations scattered throughout the United States were used to study the diurnal variation of summertime thunderstorm activity. The results of this study are summarized in isoline frequency charts giving monthly values of the 24-hour mean, the variance of the mean hourly values, hours of maximum frequency, and the phase, amplitude, and explained variance of the diurnal and semidiurnal harmonics. Author (GRA)

**N71-33236#** National Science Foundation, Washington, D.C.
**A BRIEF SUMMARY: RESEARCH OF THE INSTITUTE OF EXPERIMENTAL METEOROLOGY IN THE FIELD OF CLOUD PHYSICS AND CLOUD MODIFICATION**
H. Uttinger 1971 44 p refs Transl. into ENGLISH from the Monograph "Kratkii Obzori Issledovanii Instituta Eksperimentalnoi Meteorologii v Oblasti Fiziki Oblakov i Artivnykh Vozdeistvii" Obnisk, 1969 65 p
(TT-70-50141) Avail: NTIS CSCL 04B

Studies in the Soviet Union dealing with cloud modification are reported which have been carried out in the following directions: modification with the aim of preventing hail damage, modification intended to increase or reduce precipitation over a given territory and dispersal of the cloud cover over a given region. These studies were implemented to clarify the following problems: determination of the recurrence of situations, whereby some specific modification is possible; assessment of the physical conditions in cloud systems under certain meteorological conditions; determination of the mechanism by which various agents accelerate precipitation under real conditions; performance of cloud-modification experiments and subsequent consideration of their application in practice. Author (GRA)

**N71-33288#** Swiss Inst. of Meteorology, Zurich.
**CLIMATOLOGY OF SWITZERLAND PRECIPITATION [NIEDERSCHLAG: KLIMATOLOGIE DER SCHWEIZ]**
H. Uttinger 1970 150 p refs In GERMAN
Avail: NTIS

Daily and monthly precipitation measurements from numerous Swiss weather stations are presented in tables. The meteorological data cover the period of 1901 to 1960 and include also measuring station heights as well as median numbers of days with precipitation for the different seasons. Transl. by G.G.

**N71-33382** Freie Univ., Berlin (West Germany). Inst. fuer Meteorologie und Geophysik.
**METEOROLOGICAL REPORTS: RESULTS FROM THE METEOROLOGICAL WEATHER SERVICE FOR THE YEAR 1971; DAILY WEATHER MAPS (GROUND, 500 mb, 300 mb) AND BRIEF SCIENTIFIC STUDIES [METEOROLOGISCHE ABHANDLUNGEN: ERGEBNISSE DES SYNOPTISCHEN DIENSTES IM JAHRE 1971; TAGLICHE WETTERKARTEN (BODEN, 500 mb, 300 mb) UND KLEINERE WISSENSCHAFTLICHE AUFSAETZE]**
Jan. 1971 233 p refs In GERMAN
Avail: Issuing Activity

Detailed results of the synoptic weather service are presented in daily and hourly weather charts of ground-, 500 mb-, and 300 mb-height levels for the month of January, 1971. The Northern Hemisphere maps depict atmospheric pressures, temperatures, wind circulation, and humidity. A chart contains radioactivity measurements in air and precipitations. Included are also brief scientific papers on climatological changes of the Artic, short wave propagation in the ocean-atmosphere system, winter sport weather forecastings, and local Berlin weather measurements. Transl. by G.G.

**N71-33411#** ARO, Inc., Arnold Air Force Station, Tenn.
**ENVIRONMENTAL TESTS OF METEOROLOGICAL RADIOSONDES INCLUDING DYNAMIC TEMPERATURE AND HUMIDITY SIMULATION IN A WIND TUNNEL Final Report, 23 Sep.-20 Nov. 1970**
R. S. Hiers Jun. 1971 67 p
(Contract F40600-71-C-0002)
(AD-724688; AEDC-TR-71-99; ARO-VKF-TR-71-46) Avail: NTIS CSCL 4/2

An experimental investigation of the performance of meteorological radiosondes subjected to controlled variations of humidity and temperature in an environmental wind tunnel is described. Dynamic variations in temperature between -60 and 40C and in relative humidity between 0 and 100 percent, representative of those encountered in atmospheric flight were simulated by injecting liquid nitrogen or steam, respectively, into the wind-tunnel air supply. Tests were conducted at free-stream velocities of 15 and 75 ft/sec duplicating the average ascent and descent rates, respectively, of balloon-borne rawinsondes and dropsondes. Free-stream static pressures appropriate to the 300- and 700-mb levels were employed. Author (GRA)

**N71-33419#** Bureau of Meteorology, Melbourne (Australia).
**TROPICAL CYCLONES IN THE NORTHERN AUSTRALIAN**

**REGIONS, 1967–1968 SEASON**
1968 54 p
Avail: NTIS

A review of tropical cyclones for the Australian Region during the 1967-1968 season is presented. A case history is presented for each tropical disturbance along with a general discussion of the cyclone season for Northern, Northeastern, and Northwestern Australia. Synoptic analyses are included for each storm. F.O.S.

**N71-33583#** National Aerospace Lab., Tokyo (Japan).
**MEASUREMENTS AND ANALYSIS OF ATMOSPHERIC TURBULENCE ON THE PACIFIC COAST AIR ROUTE OF THE TOHOKU DISTRICT**
Kazuyuki Takeuchi, Koichi Ono, Kosaburo Yamane, Kenji Yazawa, and Tokuo Sotozaki Oct. 1970 35 p refs In JAPANESE; ENGLISH summary
(NAL-TR-222) Avail: NTIS

Measurements on atmospheric turbulence were made on Japanese air routes. A tape recorder with fourteen tracks was used to record normal and horizontal accelerations and angular velocities at C.G. to give the airplane attitude, as well as the airspeed and the wind directions measured by flow vanes attached to the nose and wing tip. The wind direction was used to obtain the turbulence velocities. Temperatures, altitude, and displacements of the control surfaces were also recorded. The data were analyzed to obtain the turbulence spectrum and the relationship between the measured items including atmospheric temperature. Author

**N71-33618#** National Environmental Satellite Center, Washington, D.C.
**THE USE OF SATELLITE-OBSERVED CLOUD PATTERNS IN NORTHERN HEMISPHERE 500-mb NUMERICAL ANALYSIS**
Roland E. Nagle and Christopher M. Hayden Apr. 1971 51 p refs
(NOAA-TR-NESS-55) Avail: SOD $0.55

A quasi-objective method for deriving 500-mb geopotential heights with the aid of satellite cloud observations is presented. The method uses satellite-observed cloud patterns in conjunction with a forecast 500-mb height field which is separated into additive short- and long-wave component fields. Empirical relationships between the cloud patterns and the short-wave component field are used to modify the pattern of the latter, and regression equations are used to specify extrema values. The 500-mb heights are retrieved by the direct addition of the modified short-wavelength field to the long-wavelength field. Procedures for using this method operationally are presented, and results of real-time application are shown. It is concluded that the resulting modifications can contribute to significant improvements in the analysis. Author

**N71-33619#** Finnish Meteorological Office, Helsinki.
**LIGHTNING-COUNTER MEASUREMENTS IN FINLAND DURING 1970 [SALAMANLASKIJATOIMINTA SUOMESSA VUONNA 1970]**
Leila Laitinen 1970 11 p refs In FINNISH; ENGLISH summary *Its* Meteorol. Bull. No. 22
Avail: NTIS

Tabular data give the number of registrations at 58 stations during different summer months, the number of strokes per 100 sq km, and the number of days when at least 5 registrations occurred. Also included are the mean stroke values for each station during the summer months from 1960 through 1970. Plots depict the number of thunderstorm days, based on visual or aural observations by the meteorological posts. Author

**N71-33671#** Department of Supply, Melbourne (Australia). Aeronautical Research Labs.
**CLEAR AIR TURBULENCE IN THE AUSTRALIAN STRATOSPHERE**
C. K. Rider and M. R. Thomson Jan. 1971 14 p refs *Its* Struct. and Mater. Note 362
Avail: NTIS

During the HICAT investigation in 1966, an instrumented U2 aircraft flew eight flights into the stratosphere over Australia in a search of clear air turbulence which might be of importance for SST flight. The most interesting features are summarized as follows: Patches of CAT may exceed 100 miles in dimension and persist for at least 2 hours. The terrain some 60,000 ft below flight level appears to influence the nature of CAT experienced; the presence of strong jet streams appears related to the occurrance of severe CAT. Horizontal temperature gradients of several degrees in a few miles may occur within the turbulent region. Author

**N71-33831#** Weapons Research Establishment, Salisbury (Australia). Dept. of Supply.
**MEASUREMENTS OF THE BASIC ATMOSPHERIC PARAMETERS AT WOOMERA USING THE FALLING SPHERE, 1970**
S. G. Johnson Apr. 1971 73 p refs
(WRE-TN-50) Avail: NTIS

In 1970, the falling sphere experiment was reintroduced to the Weapons Research Establishment's upper atmosphere research program of experiments to measure the variations of atmospheric density, temperature, pressure and winds. The results of five soundings are presented. Densities, temperatures and pressure values are compared with model atmospheres. Author

**N71-33835** National Oceanic and Atmospheric Administration, Silver Spring, Md. Environmental Data Service.
**CATALOG OF METEOROLOGICAL SATELLITE DATA: ESSA 9 TELEVISION CLOUD PHOTOGRAPHY, 1 APRIL–30 JUNE 1969**
1970 204 p refs *Its* Key to Meteorological Records Documentation No. 5.322
Avail: SOD $2.00

Tabulated listings give descriptive information about the pictures obtained by ESSA 9. Two digitized cloud maps are presented for each day; the first stereographic projection in each set is for the Northern Hemisphere, and the second for the Southern Hemisphere. Author

**N71-33847** Freie Univ., Berlin (West Germany). Inst. fuer Meteorologie und Geophysik.
**METEOROLOGICAL DATA, VOLUME 113, NO. 4: BERLIN READINGS, DIGITAL AND ANALOG RESULTS FROM THE CENTRAL MEASUREMENT REGISTRATION FACILITY AND FROM OTHER INSTRUMENTS FOR 1970, PART 4 Quarterly Report [METEOROLOGISCHE ABHANDLUNGEN, BAND 113, HEFT 4: BERLINER MESSWERTE: DIGITALE UND ANALOGE ERGEBNISSE DER ZENTRALEN MESSWERTREGISTRIERANLAGE UND WEITERER INSTRUMENTE FUER DAS JAHR 1970, TEIL 4: VIERTELJAHR]**
1970 379 p refs In GERMAN
(QR-4) Avail: Issuing Activity

Meteorological charts are presented that contain measurement data from the Berlin weather station. Tables depict atmospheric pressure, wind direction and velocity, atmospheric temperature, atmospheric humidity, ground temperature, solar radiation, and atmospheric statistics for the period October 1 through December 31, 1970. G.G.

**N71-33852#** Schweizerischen Meteorologischen Zentralanstalt, Druck

**DATA FROM THE SWISS CENTRAL METEOROLOGICAL INSTITUTE, ONE HUNDRED AND SIXTIETH YEAR [ANNALEN DER SCHWEIZERISCHEN METEOROLOGISCHEN ZENTRALANSTALT, HUNDERTSECHSTER JAHRGANG]**
1969 208 p In GERMAN
Avail: NTIS

Meteorological charts covering the year 1969 are presented from several Swiss weather stations. Daily data include pressure, temperature, cloud, rain, wind, snow height, and relative atmospheric humidity. Author

**N71-33853#** Schweizerischen Meteorologischen Zentralanstalt, Druck
**RESULTS FROM DAILY PRECIPITATION MEASUREMENTS BY THE METEOROLOGICAL AND RAIN MEASUREMENT STATIONS OF SWITZERLAND [ERGEBNISSE DER TAEGLICHEN NIDERSCHLAGSMESSUNGEN AUF DEN METEOROLOGISCHEN UND REGENMESS-STATIONEN DER SCHWEIZ]**
1969 126 p In GERMAN
Avail: NTIS

Meteorological tables presented contain daily and mean monthly precipitation measurement data for the year 1969 obtained at various Swiss weather stations. Transl. by G.G.

**N71-33854** Freie Univ., Berlin (West Germany).
**METEOROLOGICAL DATA. VOLUME 116, NO. 4: DAILY ALTITUDE MAPS OF THE 100 mb LEVEL AND THE 50 mb LEVEL AS WELL AS MONTHLY MEAN MAPS FOR 1970 Quarterly Report, Part 4 [METEOROLOGISCHE ABHANDLUNGEN. BAND 116, HEFT 4: TAEGLICHE HOEHENKARTEN DER 100-MB-FLAECHE UND DER 50-MB-FLAECHE SOWIE MONATLICHE MITTELKARTEN FUER DAS JAHR 1970. TEIL 4, 4. VIERTELJAHR]**
Barbara Kriester, Karin Labitzke, Renate Lenschow, Wolfgang Roeder, Richard Scherhag et al 1970 221 p In GERMAN; ENGLISH summary
(QR-4-Pt-4) Avail: Issuing Activity

Stratospheric weather maps presented contain daily height and temperature analyses of constant pressure levels for three months for the whole of the Northern Hemisphere, based on rawinsonde and in the upper stratosphere also on rocketsonde data and performed with the aid of a hydrostatic build-up method. The corresponding monthly mean maps, their variations and deviations are included as well as the mean gridpoint data, calculated from daily values. Moreover, the stratospheric circulation of polar, middle, and tropical latitudes is described for the period under consideration. Author

**N71-33855** Freie Univ., Berlin (West Germany).
**METEOROLOGICAL DATA. VOLUME 103, NO. 2: WEATHER SATELLITE OBSERVATIONS AND THEIR EVALUATION. THE EUROPEAN CLIMATOLOGY, 1969, PART 2 Quarterly Report [METEOROLOGISCHE ABHANDLUNGEN. BAND 103, HEFT 2: WETTERSATELLITENBEOBACHTUNGEN UND IHRE AUSWERTUNG. DAS EUROPAEISCHE WETTERBILD 1969, TEIL 2 VIERTELJAHR]**
Matthias Eckardt, Ingrid Haupt, and Horst Malberg 1970 247 p In GERMAN; ENGLISH summary
(QR-2-Pt-2) Avail: Issuing Activity

Meteorological satellite observations obtained in Berlin during the second quarter of 1969 are presented. A description of the orbital elements, the instrumentation, the experiments and the first results for Nimbus 3 (B-2) which was launched on April 14, 1969 is given. Some remarks on the snow and ice conditions in the European area for the period April through June, 1969 are quoted as well. Included are a daily European weather map for the second quarter of 1969, the respective orbital data for ESSA 6, ESSA 8, and Nimbus 3 as well as special data for the APT pictures taken in Berlin. Author

**N71-33910** Freie Univ., Berlin (West Germany). Inst. fuer Meteorologie und Geophysik.
**METEOROLOGICAL DATA. VOLUME 120, NO. 3: RESULTS OF THE SYNOPTIC SERVICE DURING 1971. DAILY WEATHER MAPS (GROUND, 500 mb, 300 mb) AND BRIEF SCIENTIFIC ARTICLES, MARCH [METEOROLOGISCHE ABHANDLUNGEN. BAND 120, HEFT 3: ERGEBNISSE DES SYNOPTISCHEN DIENTSES IM JAHRE 1971. TAEGLICHE WETTERKARTEN (BODEN, 500 mb, 300 mb) UND KLEINERE WISSENSCHAFTLICHE AUFSAETZE, MAERZ]**
1971 214 p refs In GERMAN
Avail: Issuing Activity

Stratospheric weather maps presented contain daily and monthly ground level, 500 mb, and 300 mb height and temperature analyses of constant pressure levels for the Northern Hemisphere obtained during March 1971, with emphasis on the atmospheric circulation affecting Germany. Brief scientific studies included discuss synoptic weather forecasting for March 1971, dimensions of rain catching sinks, comparisons of visual cloud observations with synoptic periods and cloud photos, and median wind values for Berlin, Germany. Transl. by G.G.

**N71-33911** Freie Univ., Berlin (West Germany). Inst. fuer Meteorologie und Geophysik.
**METEOROLOGICAL DATA. VOLUME 120, NO. 2: RESULTS OF THE SYNOPTIC SERVICE DURING 1971. DAILY WEATHER MAPS (GROUND, 500 mb, 300 mb) AND BRIEF SCIENTIFIC ARTICLES, FEBRUARY [METEOROLOGISCHE ABHANDLUNGEN. BAND 120, IM JAHRE 1971. TAEGLICHE WETTERKARTEN (BODEN, 500 mb, 300 mb) UND KLEINERE WISSENSCHAFTLICHE AUFSAETZE, FEBRUAR]**
1971 215 p refs In GERMAN
Avail: Issuing Activity

Stratospheric weather maps presented contain daily and monthly ground level, 500 mb, and 300 mb height and temperature analyses of constant pressure levels for the Northern Hemisphere obtained during February 1971, with emphasis on the atmospheric circulation affecting Germany. Brief scientific studies included discuss synoptic weather forecasting for February 1971, precipitation history for Berlin during 1970, artificial radioactivity levels, and winter sport weather forecasts. Transl. by G.G.

**N71-33916** Frie Univ., Berlin (West Germany).
**METEOROLOGICAL DATA. VOLUME 114, NO. 3: DAILY GROUND AND 850-MILLIBAR MAPS OF THE NORTHERN HEMISPHERE FOR 1970, PART 3 Quarterly Report, 1 Jul.–30 Sep. 1970 [METEOROLOGISCHE ABHANDLUNGEN. BAND 114, HEFT 3: TAEGLICHE BODEN- UND 850-MB-KARTEN DER NORDHEMISPHAERE IN JAHRE 1970, TEIL 3, 3. VIERTELJAHR]**
Manfred Geb, Richard Scherhag et al 1970 187 p In GERMAN
(QR-3) Avail: Issuing Activity

Stratospheric weather maps presented contain daily ground level and 850-mb height and temperature analyses of constant pressure levels for the Northern Hemisphere obtained during the third quarter of 1970. The stratospheric circulation of polar, middle, and tropical latitudes is also indicated. Transl. by G.G.

**N71-33917** Frie Univ., Berlin (West Germany).
**METEOROLOGICAL REPORTS. VOLUME 114, NO. 4: DAILY GROUND- AND 850-mb CHARTS OF THE NORTHERN HEMISPHERE FOR 1970, PART 4, FOURTH QUARTER [METEOROLOGISCHE ABHANDLUNGEN. BAND 114, HEFT**

**24. TAEGLICHE BODEN- UND 850-MB-KARTEN DER NORDHEMISPHAERE IN JAHRE 1970, TEIL 4, 4 VIERTELJAHR]**

Manfred Geb, Richard Scherhag et al 1970 187 p In GERMAN
(QR-4) Avail: Issuing Activity

Stratospheric weather maps presented contain daily ground level and 850-mb height and temperature analyses of constant pressure levels for the Northern Hemisphere obtained during the fourth quarter of 1970. The stratospheric circulation of polar, middle, and tropical latitudes is also indicated. G.G.

**N71-33974*#** National Severe Storms Lab., Norman, Okla.
**EVALUATION OF ROUGHNESS LENGTHS AT THE NSSL-WKY METEOROLOGICAL TOWER**

Leslie D. Sanders and Allen H. Weber Aug. 1970 25 p refs Sponsored in part by NASA
(NASA-CR-121475; ESSA-TM-ERLTM-NSSL-47) Avail: NTIS CSCL 04D

Wind and temperature sensors were installed to 1458 ft above ground on the transmitting tower of WKY-TV, Oklahoma City; the tower site, instrumentation, and surrounding terrain are described. Wind profiles averaged over 15 to 25 minute periods of neutral stability were used to estimate the surface roughness length, z sub o, whose mean values range from less than 1 to 14 cm for different wind directions. Plots of the standard deviation of horizontal wind direction vs. ln(z/z sub o) are compared with the theoretical curve derived from work of Panofsky and Prasad, with mixed results. Estimates of friction velocity derived from measurements of vertical velocity with a UVW anemometer in four cases lead to estimates of z sub o similar to those obtained by wind profile extrapolation. Author

**N71-33995#** National Defense Research Organization TNO, The Hague (Netherlands). Physics Lab.
**INFLUENCE OF THE EMISSION AND THE TRANSMISSION OF THE ATMOSPHERE [INVLOED VAN DE EMISSIE EN DE TRANSMISSIE VAN DE ATMOSFEER]**

A. N. de Jong and J. van Schie Nov. 1970 52 p refs In DUTCH; ENGLISH summary
(PhL-1970-26) Avail: NTIS

The influence of the atmosphere on the performance of thermal imaging systems is studied. Contrast reduction, as a consequence of atmospheric emission is investigated qualitatively. It is proposed, to measure over a longer period the absorption and emission of the atmosphere, in relation to the visual range and other meteorological conditions. Author

**N71-33997** World Meteorological Organization, Geneva (Switzerland). World Weather Watch.
**CONSOLIDATED LIST OF VOLUNTARY ASSISTANCE PROGRAMME PROJECTS APPROVED FOR CIRCULATION IN 1970**

Jan. 1971 237 p
(WMO-289) Copyright. Avail: Issuing Activity

National programs proposed for Meteorological World Data Center are described. Cost estimation is given for each country, and the final WMO president's decision for program implementation financial assistance is stated. ERSO

# 21 NAVIGATION

Includes guidance; autopilots; star and planet tracking; inertial platforms; and air traffic control. For related information see also: 07 Communications.

**N71-32850#** Technische Univ., Berlin (West Germany). Inst. fuer Flugfuehrung und Luftverkehr.
**SYSTEMS AND EQUIPMENT OF CONVENTIONAL AIRCRAFT FOR APPROACH AND LANDING [VERFAHREN UND AUSRUESTUNG KONVENTIONELLER FLUGZEUGE FUER ANFLUG UND LANDUNG]**

Manfred Fricke and Horst Busecker Aug. 1970 118 p refs In GERMAN
(Rept-52) Avail: NTIS

Based on the subdivision of the landing sequence (begin approach, intermediary approach, end approach, and landing) the presently accepted operational steps in all weather landing for civil aviation are explained. The available navigation and landing systems are analyzed in regard to their functional principles, and accuracy. ESRO

**N71-32881#** Decca Navigator Co., Ltd., London (England). Technical Publications Dept.
**DECCA NAVIGATOR MARK 19: OPERATING INSTRUCTIONS**

Apr. 1971 23 p
Avail: NTIS

The operating instructions for the Decca Navigator Mark 19 navigation system are presented. Subjects discussed are: (1) systems description, (2) controls and indicator lights, (3) flight log pictorial display, (4) preflight checks, and (5) inflight checks. Author

**N71-32885#** Cranfield Inst. of Technology (England). Electrical and Control Engineering Dept.
**SYNTHESIS OF THE AIRCRAFT NAVIGATIONAL ACROSS-TRACK ERROR**

R. N. Lord and D. A. Overton Mar. 1971 32 p refs
(Rept-E/C-2) Avail: NTIS

Aircraft across-track errors are synthesised by means of a mathematical model using statistical parameters. A convolution program is described in which the sensitivity of the overall error to variation in accuracy of navigational fix and heading can be determined. Numerical examples relating to present and future North Atlantic navaids are presented for both subsonic and supersonic aircraft, particular attention being paid to the Gaussian/negative exponential error distribution controversy. Results show that the importance of a good fixing aid diminishes as airspeed increases when the heading becomes of prime importance. The value of synthesis as a design tool for ATC as against the uncertainties of observational methods is demonstrated. Future extensions of synthesis to along-track and inhomogeneous traffic samples are discussed. Author

**N71-32892#** Decca Navigator Co., Ltd., London (England). Technical Publications Dept.
**DECCA NAVIGATOR MARK 19: BACKGROUND NOTES**

Apr. 1970 23 p
Avail: NTIS

A description is given of the functions and development of the Decca Navigation Mark 19 receiver. The system was mainly developed to: (1) drive decometers or other numerical readouts in addition to, or instead of, the flight log, and to (2) form a solid state replacement for the Mark 8A receiver unit, capable of being installed without altering the cabling or the racking of an existing Mark 8A installation. E.H.W.

**N71-32917#** Decca Navigator Co., Ltd., London (England). Technical Publications Dept.
**DECCA NAVIGATOR MARK 25: OPERATING INSTRUCTIONS**

May 1970 18 p
Avail: NTIS

Operating instructions for the Decca Navigator Mark 25 navigation system are presented. Subjects discussed are: (1) general system description, (2) pictorial display charts, (3) confidence checks and malfunction warnings, (4) preflight instructions, and (5) inflight operations. Author

**N71-32921#** Weapons Research Establishment, Salisbury (Australia).

**WRESAT: THE SOLAR ASPECT PROBLEM**

S. G. Johnson Dec. 1970 26 p refs
(HSA-180) Avail: NTIS

A mathematical method for determining solar aspect angle from satellite magnetometer data is described. This approach was necessitated by failure of the optical aspect sensors on the Australian satellite, WRESAT, and the need for information on the position of the sun relative to the onboard ion chambers for conducting solar radiation experiments. By assuming that the spin axis of the satellite and that of the magnetometer were perpendicular, an aspect angle was determined which was in good agreement with values computed by two other techniques. Results also confirm the approximate solution obtained by considering the shape of the ion chamber response curves. A.C.R.

**N71-32996#** Laboratoire d'Automatique et de ses Applications Spatiales, Toulouse (France).

**DC-DC CONVERTER WITH ADJUSTABLE OUTPUT VOLTAGE FOR STABILIZATION SYSTEMS BY IONIC PROPULSION [CONVERTISSEUR CONTINU-CONTINU A TENSION DE SORTIE COMMANDABLE DESTINE A DES SYSTEMES DE STABILISATION PAR PROPULSION IONIQUE]**

M. Briot, A. Costes, J. C. Laprie, and J. C. Marpinard 1971 49 p refs In FRENCH Presented at the 3rd Intern. Conf. on Space Technol., Rome, 3–8 May 1971
Avail: NTIS

Different configurations have been analyzed for controlling the altitude of a synchronous geocentric satellite assuming the use of ion propulsion. It is shown that electrostatic deviation of the ejected ion jet gives the possibility to make orbit corrections as well as altitude control with the same thrustors. ESRO

**N71-33025#** Office National d'Etudes et de Recherches Aerospatiales, Paris (France).

**FRENCH PROTOTYPE OF A TIME-FREQUENCY COLLISION AVOIDANCE SYSTEM [PROTOTYPE FRANCAIS D'UNS SYSTEME ANTICOLLISION A TEMPS FREQUENCE]**

Jean Besson 1971 29 p refs In FRENCH; ENGLISH summary Presented at 10th Intern. Congr. on Aeron, Paris, 1-3 Jun. 1971
(ONERA-TP-938) Avail: NTIS

A simplified collision avoidance system, based on atomic clocks was developed and tested in France by the Crouzet Cy and O.N.E.R.A. The system was designed to automatically detect all aircraft danger, evaluate collision risk, determine avoidance maneuver, and indicates avoidance maneuver by the pilot. Flight tests show good results with the system. Transl. by E.H.W.

**N71-33058*#** Massachusetts Inst. of Tech., Cambridge. C. S. Draper Lab.

**ENTRY NAVIGATION ANALYSIS**

B. A. Kriegsman and D. E. Gustafson *In* NASA. Manned Spacecraft Center Proc. of the Space Shuttle Integrated Electron. Conf., Vol. 1 1971 p 143–166 (See N71-33051 20-31)
Avail: NTIS HC$6.00/MF$0.95 CSCL 17G

The basic navigation accuracy requirement Space Shuttle navigation requirements are discussed. For space shuttle landing stems from the fact that the vehicle must be sufficiently close to the selected runway after entry so that it can glide into a safe engines-off landing. The primary navigation sensor is an inertial measurement unit (IMU). Initial-condition errors and inertial-instrument errors cause errors in the estimate of the vehicle's state which tend to increase during the entry phase. The plasma sheath surrounding the entry body makes state-vector updating by external radio navaids very difficult during the major part of entry (from about 150,000 to 300,000 feet). The hypersonic maneuver capability of the vehicle decreases as the time remaining during entry becomes small. For this reason it is desirable to correct errors in the IMU-derived navig on data as soon as possible before the start of cruise. Author

**N71-33060*#** National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.

**A PRELIMINARY EVALUATION OF NAVIGATION AND GUIDANCE CONCEPTS FOR THE SPACE SHUTTLE ORBITER FROM THE END OF REENTRY TO TOUCHDOWN**

Robert D. Showman, William R. Wehrend, Jr., and Kenneth C. White *In its* Proc. of the Space Shuttle Integrated Electron. Conf., Vol. 1 1971 p 195–220 (See N71-33051 20-31)
Avail: NTIS HC$6.00/MF$0.95 CSCL 17G

Navigation and guidance concepts to bring the Space Shuttle Vehicle (SSV) Orbiter from the end of reentry, which is assumed to be 100,000 feet to touchdown are discussed. Both automatic and manual systems are being considered for the unpowered, high-cross range (HCR) vehicle. Conceptually, two different guidance and control systems are used during the mission. At high altitudes, an energy management system is used to guide the vehicle to a specific altitude and distance from the runway with the desired heading and velocity. An approach, flare, and runway alignment system then guides the vehicle to touchdown. Author

**N71-33061*#** National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.

**NAVIGATION FOR SPACE SHUTTLE APPROACH AND LANDING USING AN INERTIAL NAVIGATION SYSTEM AUGMENTED BY VARIOUS DATA SOURCES**

L. A. McGee, G. L. Smith, D. M. Hegarty, R. B. Merrick, T. M. Carson et al *In its* Proc. of the Space Shuttle Integrated Electron. Conf., Vol. 1 1971 p 221–256 refs (See N71-33051 20-31)
Avail: NTIS HC$6.00/MF $0.95 CSCL 17G

A navigation study program called RAINPAL - an acronym for Recursive Aided Inertial Navigation for Precision Approach and Landing - which will provide navigation information which is applicable to the stringent requirements of the unpowered SSV High Cross Range (HCR) orbiter is discussed. The objective of this study is to determine the navigation accuracy obtainable with an augmented INS (Inertial Navigation System). Augmentation of the INS is through the use of a Kalman filter (square-root form) which processes external data from several candidate data source combinations. Author

**N71-33062*#** National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.

**MULTIPLE INERTIAL MEASURING UNITS (IMU) FOR USE IN THE SPACE SHUTTLE VEHICLE (SSV)**

H. Brown, B. Doran, and T. R. Armstrong (Sperry Rand Corp., Phoenix, Ariz.) *In its* Proc. of the Space Shuttle Integrated Electron. Conf., Vol. 1 1971 p 257–268 (See N71-33051 20-31)
Avail: NTIS HC$6.00/MF$0.95 CSCL 17G

An inertial navigation system (INS) employing multiple IMUs is being considered for use on SSV. Although multiple IMU navigation systems are currently in use, SSV requirements create some unique problems with this implementation concept. Subjects

covered include: (1) SSV-INS functions and requirements, (2) background of multiple IMU usage, (3) candidate IMU configurations and a selected configuration, (4) identification of the technology areas associated with multiple IMU usage in SSV, (5) identification of specific areas in which studies are required before the shuttle INS implementation is defined, and (6) current MSFC activity in the subject area. Author

N71-33124# Army Test and Evaluation Command, Aberdeen Proving Ground, Md.
**POSITION FIXING NAVIGATION EQUIPMENT Final Report**
19 Apr. 1971 28 p
(AD-724079; MTP-6-3-207) Avail: NTIS CSCL 17/7

The document defines procedures for evaluating the suitability of navigational equipment for use in Army aircraft, surface and waterborne vehicles. Author (GRA)

N71-33747*# Massachusetts Inst. of Tech., Cambridge. Electronic Systems Lab.
**AN APPROACH TO SEMIAUTOMATED OPTIMAL SCHEDULING AND HOLDING STRATEGIES FOR AIR TRAFFIC CONTROL**
Michael Athans and Lynn W. Porter Dec. 1970 64 p refs
(Grants NGL-22-009-124; AF-AFOSR-1724-69A)
(NASA-CR-121466; AD-721474; ESL-P-437) Avail: NTIS CSCL 01B

The paper considers the problem of coordinating the traffic flow and holding patterns of N aircraft which desire to land in a single runway. A distance separation is to be enforced over the outer marker. It is shown that this problem can be attacked as a variation of a linear-quadratic optimal control problem. The solution of this optimization problem can be used to indicate which aricraft can accomplish headway corrections by velocity control, and which require to undergo path stretching or holding maneuvers. The gradual implementation of these strategies in current and evolutionary ATC systems will also be discussed. Author (GRA)

# 22 NUCLEAR ENGINEERING

Includes nuclear reactors and nuclear heat sources used for propulsion and auxiliary power. For basic research see: 24 Physics, Atomic, Molecular, and Nuclear. For related information see also: 03 Auxiliary Systems; and 28 Propulsion Systems.

N71-32919# Aerospace Research Labs., Wright-Patterson AFB, Ohio.
**THE COLLOID CORE NUCLEAR REACTOR CONCEPT Final Report**
William N. Jackomis and Bobby N. Turman Sep. 1970 36 p refs
(AD-724139; ARL-70-0167) Avail: NTIS CSCL 21/6

A review of the Colloid Core Nuclear Reactor Rocket Engine concept is given, including principal operating features, performance goals, and comparisons with other nuclear engine concepts. A brief summary of major research efforts in multi-component flow is presented, along with areas in which further investigation is needed to complete a feasibility study of the colloid core reactor design. Author (GRA)

N71-33199# Central Electricity Generating Board, Berkeley (England). Berkeley Nuclear Labs.
**MANGANESE REACTION RATE MEASUREMENTS IN BNL REACTORS**
A. J. Beynon and R. H. Waterson Jul. 1970 46 p refs
(RD/B/N-1518; RPC/RPNK/P-(71)7) Avail: AEC Depository Libraries

Manganese reaction rates were measured in a range of axially uniformly fuelled reactors designed to test theoretical techniques available for CAGR performance problems. Parameters considered were relative channel powers in the core, cross channel gradients, cross pin gradients, fuel axial and radial fine structure and moderator cell fine structure. The arrays of fuel used included vacancies and differing fuel weights and enrichments. Author (NSA)

N71-33288*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
**SHOCK TUBE TECHNIQUE FOR MEASURING OPACITIES AT HIGH PRESSURES FOR GASEOUS-CORE NUCLEAR ROCKETS**
R. W. Patch [1971] 9 p refs Proposed for presentation at the 2d Symp. on Uranium Plasmas, Atlanta, 15–17 Nov. 1971; sponsored by the AIAA
(NASA-TM-X-67902) Avail: NTIS CSCL 18E

A nonexplosive shock tube with high potential performance is described. This shock tube should produce essentially homogeneous, isothermal gases, or aerosols at conditions occurring in the propellant region in a gaseous-core nuclear rocket. The shock tube is currently under construction. A unique method of measuring the Planck and Rosseland mean opacities of shock tube gases without using high spectral resolution is derived. The selection of seed materials to be added to the gases to make them semiopaque is discussed. Author

N71-33306# Idaho Nuclear Corp., Idaho Falls.
**DISTRIBUTION OF SOLID FISSION PRODUCTS IN $UO_2$**
J. H. McFadden, V. F. Baston, and W. A. Yuill [1971] 8 p refs Presented at Meeting on New Develop. in Reactor Mathematics and Appl., Idaho Falls, Idaho, 29 Mar. 1971 Sponsored by AEC
(Conf-710302-5) Avail: NTIS

The migration of fission products during reactor operation is described by a thermomigration model that has been used successfully to describe noble gas release from fuel pins during normal operation. The basic assumption in the derivation of this model is that the driving force for migration of fission products during reactor operation is a Gibbs-free-energy gradient, which is dependent on temperature and concentration gradients. Examples of forces contributing to the Gibbs-free-energy gradient and proportional to the thermal gradient are entropy effects, thermoelectric effects and thermal stresses. Author (NSA)

N71-33308# Idaho Nuclear Corp., Idaho Falls.
**IDAHO NUCLEAR CODE AUTOMATION: A STANDARDIZED AND MODULARIZED CODE STRUCTURE**
C. W. Solbrig, L. J. Yberrondo, and R. J. Wagner Mar. 1971 28 p refs Presented at Meeting on New Develop. in Reactor Mathematics and Appl., Idaho Falls, Idaho, 29 Mar. 1971 Sponsored by AEC
(Conf-710302-10) Avail: NTIS

The Idaho Nuclear Code Automation (INCA) system to be implemented during the course of the Loss-of-Coolant Accident Analysis Program being conducted as part of the Loss-of-Fluid Test (LOFT) program is described. Most of the knowledge, both analytical and experimental, concerning nuclear safety analyses will ultimately reside in computer codes. The value and reliability of this knowledge depend upon the accessibility and ease of use of these codes. Some of the problems encountered in the present generation of nuclear safety codes are: (1) difficulty in interfacing codes, (2) inconsistency between codes, (3) long running time to ensure stability, and (4) overemphasis on empirical correlations. A comprehensive plan for developing the third generation of nuclear safety codes with an integrated code automation system that will alleviate these difficulties is presented. Author (NSA)

N71-33309# Atomic Energy Commission, Washington, D.C.
**CORRELATIONS TO PREDICT MAXIMUM PWR CONTAINMENT PRESSURES FOLLOWING A LOSS OF COOLANT ACCIDENT**
D. C. Slaughterbeck [1971] 16 p refs Presented at Meeting on New Develop. in Reactor Mathematics and Appl., Idaho Falls, Idaho, 29 Mar. 1971
(Conf-710302-9) Avail: NTIS

The correlations developed on the basis of a parametric analysis of a simplified containment model provide a method for prediction of the maximum containment pressures in large PWR containments following a loss-of-coolant accident. The figures provide the framework to account for initial fluid enthalpies, heat transfer to the steam generators during blowdown, and heat absorption in the containment structures. The trend of pressure estimated with the correlations agrees with predictive data from safety analysis reports. Author (NSA)

N71-33390# National Bureau of Standards, Washington, D.C.
**REACTOR RADIATION DIVISION Annual Progress Report, Period Ending 31 Oct. 1970**
Robert S. Carter, ed. Mar. 1971 67 p refs
(NBS-TN-567) Avail: SOD $0.70

Applications of the nuclear reactor to various projects are summarized including thermal neutron flux measurements, crystallographic studies of metal organic materials, proton dynamics and phase transitions in transition metal hydrides, studies of simple liquids, equipment development, trace constituents of geological materials, neutron activation analysis in scientific crime detection, and trace elements in the environment. J.M.

N71-33426# Atomic Energy Commission, Washington, D.C. Reactor Standards Div.
**SAFETY GUIDES FOR WATER COOLED NUCLEAR POWER PLANTS**
2 Nov. 1970 48 p refs
(TID-25697) Avail: NTIS

Guides are presented which are intended to identify specific safety issues that should be considered in the design and in the evaluation of water cooled nuclear power plants and to describe a set of principles and specifications which, if satisfied, will represent an acceptable solution of these issues to the U. S. AEC regulatory staff and the Advisory Committee on Reactor Safeguards. The guides include: (1) net positive suction heat for emergency core cooling and containment heat removal system pumps; (2) thermal shock to reactor pressure vessels; (3) assumptions used for evaluating the potential radiological consequences of a loss of coolant accident for boiling water reactors; (4) assumptions used for evaluating the potential radiological consequences of a loss of coolant accident for pressurized water reactors; (5) assumptions used for evaluating the potential radiological consequences of a steam line break accident for boiling water reactors. NSA

N71-33542# Idaho Nuclear Corp., Idaho Falls.
**MATHEMATICAL TECHNIQUES FOR VIBRATION ANALYSIS OF REACTOR SYSTEMS**
C. Noble [1970] 14 p refs Presented at the Meeting on New Develop. in Reactor Math. and Appl. Idaho Falls, Idaho, 29 Mar. 1971 Sponsored by AEC
(Conf-710302-7) Avail: NTIS

The vibration analysis of a nuclear reactor by the finite element method can be divided into three major steps: generating the stiffness and mass matrices, determining the natural frequencies (eigenvalues) and mode shapes (eigenvectors), and solving the uncoupled equations of motion for displacements in normal coordinates. The mathematical techniques used to solve the eigenvalue problem and techniques to solve the differential equations for displacements in normal coordinates are described. The eigenvalue problem is solved by the STRAP-D code, which reduces the dimensions of the stiffness matrix by condensing, and by the STRAP-MS code which reduces the dimensions by modal synthesis. The solution of the equations of motion is accomplished by Laplace transform techniques. Author (NSA)

N71-33544# Argonne National Lab., Ill.
**INSTRUMENTATION SYSTEMS TO PROTECT LMFBR CORE INTEGRITY**
W. C. Lipinski, C. E. Cohn, D. R. MacFarlane, T. P. Mulcahey, D. Okrent et al Mar. 1971 244 p refs
(Contract W-31-109-eng-38)
(ANL-7793) Avail: NTIS

The role of instrumentation systems in providing protection for cores of future liquid-metal-cooled fast breeder reactors is described. The existing status of instrumentation systems for core protection is reviewed and consideration given to how such systems might be improved, through extension of current technology in the areas of detectors, circuitry, and information processing. Credible types of accidents and malfunctions are considered, in order to establish the time scale required for instrument system response and action. Emphasis is given to the effectiveness of various types of detection systems in providing protection against localized abnormalities. An indication is given of the direction for future developmental activities in order to satisfy the dual requirements of reliability and economy in systems intended to insure fast-reactor safety. Author (NSA)

N71-33626*# Florida Univ., Gainesville.
**RESEARCH ON URANIUM PLASMAS AND THEIR TECHNOLOGICAL APPLICATIONS**
Karlheinz Thom and Richard T. Schneider, eds. Washington NASA 1971 503 p refs Symp. held at Gainesville, Fla., 7–8 Jan. 1970 Sponsored by NASA
(NASA-SP-236) Avail: SOD $3.75; NTIS CSCL 18E

Studies on uranium plasma physics and applications, especially in gaseous core reactors, are presented. The topics cover reactor concepts, plasma properties, nucleonics and radiation, nuclear light bulb engines, MHD power generation, nuclear lasers, and containment, flow, and stability. For individual titles, see N71-33627 through N71-33668.

N71-33627*# Atomic Energy Commission, Washington, D.C.
**COMPARISON OF CLOSED AND OPEN CYCLE SYSTEMS**
F. C. Schwenk and C. E. Franklin *In* Florida Univ. Res. on Uranium Plasmas and Their Technol. Appl. 1971 p 3–11 refs (See N71-33626 20-22)
Avail: SOD $3.75; NTIS CSCL 18E

The nuclear light bulb and the coaxial flow, gaseous core reactors are described. Calculated critical masses for both the open cycle and the closed cycle systems are evaluated, emphasizing neutronic requirements and characteristics. The transparent wall in the nuclear light bulb and fluid mechanics in both systems are also examined. To heat hydrogen and to attenuate radiant energy in the gas core propellant, the fuel was seeded with either a gas having a low ionization potential or with submicron-sized particles of a highly absorbing material. J.A.M.

N71-33628*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
**RELATIONSHIP BETWEEN ENGINE PARAMETERS AND THE FUEL MASS CONTAINED IN AN OPEN CYCLE GAS CORE REACTOR**
Robert G. Ragsdale *In* Florida Univ. Res. on Uranium Plasmas and Their Technol. Appl. 1971 p 13–22 refs (See N71-33626 20-22)
Avail: SOD $3.75; NTIS CSCL 18E

An analysis is carried out to relate the amount of uranium that would be contained in an engine to engine performance parameters. The parameters considered are: cavity diameter, reactor pressure, engine thrust, specific impulse, and the hydrogen to-uranium flow rate ratio. Several auxiliary equations are developed as a part of the analysis. Recent fluid mechanics experimental data are used to show that the fraction of the reactor cavity filled with uranium is inversely proportional to the approximate cube root of the hydrogen-to-fule flow rate ratio. Equations are also developed that give the uranium density and opacity as a function of reactor pressure and fuel temperature. These equations are incorporated into a simplified radiant heat transfer equation. Author

N71-33629*# United Aircraft Corp., East Hartford, Conn. Research Labs.

**SUMMARY OF RESEARCH ON THE NUCLEAR LIGHT BULB REACTOR**

James W. Clark and George H. McLafferty *In* Florida Univ. Res. on Uranium Plasmas and Their Technol. Appl. 1971 p 23–27 refs (See N71-33626 20-22)

(Contracts NASw-847; SNPC-70)

Avail: SOD $3.75; NTIS CSCL 18E

The overall nuclear light bulb research program is outlined, along with the progress to date. A thermal environment was simulated for ratio frequency experiments. Results of radiant energy source tests, transparent wall model tests, and propellant heating experiments are summarized. Engine dynamics and startup analyses using a UNIVAC 1108 digital computer is briefly discussed, as well as radiation heat transfer and optical absorption in fused silica. J.A.M.

N71-33630*# Westinghouse Electric Corp., Pittsburgh, Pa. Astronuclear Lab.

**THE COLLOID CORE CONCEPT: A POSSIBLE FORERUNNER FOR THE GASEOUS CORE**

Y. S. Tang, J. S. Stefanko, and P. W. Dickson *In* Florida Univ. Res. on Uranium Plasmas and Their Technol. Appl. 1971 p 29–36 refs Sponsored by ARL (See N71-33626 20-22)

Avail: SOD $3.75; NTIS CSCL 18E

A concept using a colloid-fuel, vortex chamber cavity is described. Theoretical analysis of the system characteristics and a conceptual design of a ground test reactor are included. The reactor uses particulate fuel with a composition (1U-10Zr)C. The uranium is U-233, and the fuel is fed to the cavity by hydrogen gas. The cavity, a compressed vortex chamber, has an L/D ratio of 0.15 in the fuel-bearing zone. Beryllium is used as the reflector material. The reflector, as well as the other core components, is cooled by hydrogen passages and is contained in a titanium alloy (T-Al-V) pressure vessel. The engine would generate a 100,000-lb thrust with a specific umpulse of 1200 lb-sec/lbm. Author

N71-33631*# Nevada Univ., Reno.

**PULSED PLASMA CORE ROCKET REACTORS**

F. Winterberg *In* Florida Univ. Res. on Uranium Plasmas and Their Technol. Appl. 1971 p 37–45 refs (See N71-33626 20-22)

(Grant NGR-29-001-016)

Avail: SOD $3.75; NTIS CSCL 18E

It is shown that the two principal problems of gas-core reactors, i.e., fuel-propellant separation and material problems resulting from the high operating temperatures, can be greatly reduced in a pulsed operation to very high temperatures by a fast-growing chain reaction. An expression for the reactor economy is derived which shows that with increasing maximum temperature in the pulsed reactor operation, the same fuel burnup is possible with a smaller fuel propellant separation. In the limiting case of temperatures above 10 to the 7th power K, represented by the bomb propulsion concept, no separation is needed. The other limiting case, that of complete separation realized in the solid-core rocket reactor, can also be recovered from the general formula. Author

N71-33632*# Computer and Applied Sciences, Inc., Philadelphia, Pa.

**GASEOUS FISSION CLOSED LOOP MHD GENERATOR**

Arthur Sherman *In* Florida Univ. Res. on Uranium Plasmas and Their Technol. Appl. 1971 p 47–51 refs (See N71-33626 20-22)

Avail: SOD $3.75; NTIS CSCL 18E

The question of achieving a very low specific weight for a nuclear electric space power plant in order that an electrical propulsion system could prove very attractive for space flight is considered. The study of a gaseous fission reactor operating at moderate temperatures in a closed-loop power plant with an MHD generator as the energy converter is suggested. Author

N71-33634*# United Aircraft Corp., East Hartford, Conn. Research Labs.

**EXPERIMENTS ON THE CONTAINMENT OF SIMULATED FUEL IN UNHEATED AND HEATED VORTEXES**

Arthur E. Mensing and Jerome F. Jaminet *In* Florida Univ. Res. on Uranium Plasmas and Their Technol. Appl. 1971 p 65–69 refs (See N71-33626 20-22)

(Contracts NASw-847; SNPC-70)

Avail: SOD $3.75; NTIS CSCL 18E

Experiments were conducted to investigate the simulated-fuel containment characteristics of vortex flows similar to those which would be employed in a nuclear light bulb engine. Isothermal tests using a 10-in.-diam vortex chamber showed that volume-averaged simulated-fuel partial pressures in excess of those required for the nuclear light bulb engine are feasible. Similar tests using a 1.26-in.-diam vortex chamber in which a temperature gradient of approximately 50,000 K/in. was impressed on the vortex flow showed that the temperature gradient resulted in a substantial reduction in the diffusion of the simulated fuel to the peripheral wall of the vortex chamber. The results of experiments with both heated and unheated vortex flows are summarized. Author

N71-33636*# United Aircraft Corp., East Hartford, Conn. Research Labs.

**EXPERIMENTAL STUDY OF THE EFFECT OF INLET CONDITIONS ON THE FLOW AND CONTAINMENT CHARACTERISTICS OF COAXIAL FLOWS**

Bruce V. Johnson *In* Florida Univ. Res. on Uranium Plasmas and Their Technol. Appl. 1971 p 83–93 refs (See N71-33626 20-22)

(Contract NASw-847)

Avail: SOD $3.75; NTIS CSCL 18E

Exploratory experiments for studying coaxial flow characteristics for gas core nuclear rockets are described. The path of the simulated propellant is approximately in the direction of the axis of symmetry and the flow cross sectional area is approximately constant for a significant distance from the inlet. The large eddy disturbances which occurred in previous coaxial flow jet tests with discontinuous inlet velocity profiles were essentially eliminated by the use of a porous material upstream of the inlet plane to smooth out the inlet velocity profiles. (Use of these materials also decreased the rms axial velocity fluctuation from 40% to approximately 7% in the test chamber near the inlet plane.) The apparent inner jet gas containment obtained with the modified porous-material inlets was considerably improved. With Freon 11 as the inner jet gas, the containment at a ratio of outer stream flow rate to inner jet flow rate of 25 was twice that for previous tests. Author

N71-33639*# Massachusetts Inst. of Tech., Cambridge.
**STABILITY CONSIDERATIONS FOR A TRANSPARENT WALL IN A GASEOUS NUCLEAR ROCKET**
C. K. W. Tam, D. B. Goracke, and W. S. Lewellen *In* Florida Univ. Res. on Uranium Plasmas and Their Technol. Appl. 1971 p 129–133 refs (See N71-33626 20-22)
(Contract NSR-22-009-288)
Avail: SOD $3.75; NTIS CSCL 18E

The stability of infinitesimal disturbances on an inviscid, incompressible model of coaxial flow around a cylinder of stationary fluid of differing density separated by a thin, flexible wall is studied. The pinch mode of disturbance is found to be the most unstable. The wall strength required to insure that no disturbance will grow along the boundary is determined as a function of density ratio and the dynamic pressure of the flow. A numerical example indicates that adequate strength can be obtained within the thickness limit imposed by the heat absorption constraint existing in the nuclear light bulb concept of a gaseous nuclear rocket, but the margin is close enough to suggest that other possible additive effects merit further analysis. Author

N71-33641*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
**GAS CORE NUCLEAR ROCKET WITH FUEL SEPARATION BY MHD DRIVEN ROTATION**
Chul Park and Wendell L. Love *In* Florida Univ. Res. on Uranium Plasmas and Their Technol. Appl. 1971 p 139–148 refs (See N71-33626 20-22)
Avail: SOD $3.75; NTIS CSCL 18E

A gas-core nuclear rocket is described in which fuel containment is achieved through the application of an MHD-centrifuge scheme. Solid-body rotation of the gas would be developed in a cylindrical cavity in order to obtain maximum separation of the fuel gas from the propellant gas. Heating of the propellant gas would be accomplished by radiative transfer from the fuel region near the wall as the propellant flows axially through the center region of the cavity. Encouraging results were obtained from a preliminary experiment to test the effectiveness of MHD-driven rotation for separating two gas species in a closed cylindrical chamber. The operating characteristics and projected performance of a gas-core nuclear rocket engine using this scheme for fuel containment were calculated and typical results are presented. Author

N71-33643*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
**STATUS OF OPACITY CALCULATIONS FOR APPLICATION TO URANIUM FUELED GAS CORE REACTORS**
R. W. Patch *In* Florida Univ. Res. on Uranium Plasmas and Their Technol. Appl. 1971 p 165–171 refs (See N71-33626 20-22)
Avail: SOD $3.75; NTIS CSCL 18E

The principal mode of heat transfer in gas-core nuclear reactors and rockets is thermal radiation. In order to assess the feasibility of such reactor and rocket concepts, the opacities of the substances in the reactor chamber must be known from calculations or experiments. The status and results of such calculations for hydrogen, seeds, and uranium are given and the status of experiments is discussed. It is concluded that present opacity calculations are probably accurate enough to assess the feasibility of a uranium-fueled gas-core reactor or rocket, but the confidence level is not yet satisfactory. Author

N71-33650*# Institute for Defense Analyses, Washington, D.C.
**NEUTRON KINETICS OF CAVITY REACTORS**
Walter N. Podney, Harold P. Smith (Calif. Univ., Davis), and A. K. Oppenheim (Calif. Univ., Berkeley) *In* Florida Univ. Res. on Uranium Plasmas and Their Technol. Appl. 1971 p 219–230 refs (See N71-33626 20-22)
(Grants NsG-702105-003-050; AF-AFOSR-129-67)
Avail: SOD $3.75; NTIS CSCL 18K

A theory is presented that describes power level variations in a cavity reactor produced by density changes in a gaseous nuclear fuel within the cavity. Effects of a density change are accounted for in terms of a cavity grayness, which is the ratio of the net thermal neutron current to thermal neutron flux at the cavity wall. The percent change in power level per neutron generation is shown to be proportional to reactivity plus a term proportional to rate of change of grayness. The rate dependent term is unique to cavity reactors and is expected to have a pronounced effect on reactor stability. Implications for stability of cavity reactors to motion of fuel within the cavity are considered. For a large cavity radius, defined in terms of a minimum critical radius, power level is sensitive to motion of fuel toward or away from the cavity wall. Expansion of a central fuel region within the cavity increases reactivity, and, conversely, contraction decreases reactivity. Power excursions with period of the order of 100 sec can result if natural damping forces provided by pressure and temperature gradients within the cavity are not strong enough or quick enough to arrest an initial expansion or contraction. Author

N71-33651*# Rensselaer Polytechnic Inst., Troy, N.Y.
**COUPLED FLUID AND NEUTRONIC OSCILLATIONS IN HIGH TEMPERATURE GASEOUS URANIUM**
Harry McNeill and Martin Becker *In* Florida Univ. Res. on Uranium Plasmas and Their Technol. Appl. 1971 p 231–235 refs (See N71-33626 20-22)
Avail: SOD $3.75; NTIS CSCL 18E

The similarity of the core of the gaseous core nuclear rocket to the combustion chamber of a chemical rocket suggests that acoustic instabilities which were troublesome in chemical rocket systems may also occur in the gaseous core nuclear rocket system. The analysis of a simplified and idealized physical model with the radiant heat transfer characteristics of a high temperature uranium plasma shows that two distinct wave phenomena can occur. One wave, called a heat wave, is stable, but the other wave, which is an acoustic wave, can become unstable. Neutronic damping due to gas dynamic field and neutron field interaction results in a significant influence toward stability of the acoustic oscillation. The results of investigations show that, even with the stabilizing effect of radiant heat transfer and neutronic damping, instabilities can occur within the size envelope of current gas core rocket conceptual designs. Author

N71-33652*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
**THE RADIANT HEAT FLUX LIMIT OF BYPASS FLOW IN A URANIUM PLASMA ROCKET**
Albert F. Kascak *In* Florida Univ. Res. on Uranium Plasmas and Their Technol. Appl. 1971 p 237–241 refs (See N71-33626 20-22)
Avail: SOD $3.75; NTIS CSCL 18E

A two dimensional radiative-convective analysis was used to calculate the temperature distribution in the annular propellant region. A diffusion approximation was used in this part of the analysis. A transport analysis was then used to calculate the wall heat flux from the propellant temperature distribution. The maximum wall heat flux increased from near zero to about 0.5 kW/sq in. when 80 percent of the total hydrogen flow was bypassed. In the wall heat flux calculation, the hydrogen in the cavity was assumed to contain 0.7 weight percent solid seed material with an absorption cross section of 50,000 sq cm/g (5000 sq m/kg). These are values that were experimentally achieved. The 0.7 weight percent of seed material in the cavity would amount to about 1 percent of the total hydrogen flow. This amount of seed would have a negligible effect on specific impulse. The overall conclusion is that

a large fraction of the hydrogen propellant can bypass the engine cavity without causing an excessive radiant heat flux on the cavity wall. Author

N71-33653*# Georgia Inst. of Tech., Atlanta.
**A STUDY OF THERMAL RADIATION ABSORPTION PROCESSES IN GAS CORE REACTORS**
W. L. Partain, J. R. Williams, and J. D. Clement *In* Florida Univ. Res. on Uranium Plasmas and Their Technol. Appl. 1971 p 243–258 refs (See N71-33626 20-22)
(Grant NGR-11-002-068)
Avail: SOD $3.75; NTIS CSCL 18E

Recent data on the thermal emission spectrum from uranium plasma indicate that the radiant energy entering the propellant region of a gas core reactor would lie in the wavelength range between 1200 and 7000 A. Since hydrogen at temperatures below about 8000 K is transparent to this radiation, it must be seeded to make it absorb this radiant energy and become heated. Submicron-sized refractory metal particles appear to be the best seed material for this application because they are highly absorbing throughout this wavelength range and can withstand high temperatures without vaporizing. Calculations using the Mie theory show that submicron-sized particles of carbon, tungsten, and silicon are highly absorbing, whereas submicron-sized particles of nonconducting materials, such as aluminum oxide, are almost purely scattering and would therefore not be useful as a seed material. The carbon-hydrogen aerosol exhibited a slight increase in extinction parameter as the temperature was raised to 2170 K. The carbon particles react with hydrogen to produce methane at temperatures above 1000 K; however, small concentrations of methane greatly retard the reaction rate. Similar measurements of the extinction parameter of tungsten-hydrogen aerosols at 12.5-atm pressure showed a significant increase in the extinction parameter with temperature from about 18,000 sq cm/g at 730 K to about 50,000 sq cm/g at 1770 K. Measurements of the scattering of a 6328-A laser beam from submicron-sized carbon, tungsten, silicon, tungsten carbide, and silicon carbide particles dispersed in nitrogen gas demonstrate the highly forward nature of the scattering. Electron micrographs illustrate the sizes and shapes of the particles used for these investigations. Author

N71-33654*# Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Stuttgart (West Germany).
**RADIATION TRANSPORT IN A URANIUM PLASMA REACTOR WITH REFLECTING WALLS**
S. Kelm and W. Peschke *In* Florida Univ. Res. on Uranium Plasmas and Their Technol. Appl. 1971 p 259–265 refs (See N71-33626 20-22)
Avail: SOD $3.75; NTIS CSCL 18E

The temperature distribution and the radiation flux is determined for the plasma region of a plasma reactor which is appropriate for MPD energy conversion. The pressure of the uranium plasma will be of the order of 50 atm. Therefore, the diameter of the fuel plasma zone should attain 1 m because the reactor must become critical. The plasma reactor investigated uses liquid lithium flowing along the inner walls of the reactor in the axial or azimuthal direction. Results from the calculations show that the total radiation flux near the walls is reduced considerably despite the very high temperatures at the middle of the reactor, and the radiation flux is reduced by the reflecting walls. Author

N71-33655*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
**RADIATION HAZARD FROM BACKFLOW OF FISSION FRAGMENTS FROM THE PLUME OF A GAS CORE NUCLEAR ROCKET**
Charles E. Masser *In* Florida Univ. Res. on Uranium Plasmas and Their Technol. Appl. 1971 p 267–271 refs (See N71-33626 20-22)
Avail: SOD $3.75; NTIS CSCL 18E

Analytical calculations are performed to determine the particle flux that leaves a rocket plume in a vacuum and strikes the rocket forward of the nozzle. The rocket plume is generated by the products of a gas-core nuclear reactor and consists of hydrogen, uranium, and fission fragments. The backflow flux is determined by the number of particles that leave the continuum of the plume and strike the rocket without experiencing any particle collisions. A percentage of these particles that strike the rocket are fission fragments and the radiation dose to the crew is calculated. A total of 1.68 lb of fission fragments is formed from a gas-core rocket that produces 1,000,000 lb of thrust at a specific impulse of 1500 sec for a propellant consumption of 1,000,000 lb. Of the 1.68 lb of fission fragments only 0.42 × 10 to the minus 8th power lb flow back from the plume and only 0.66 × 10 to the minus 10th power lb strike the rocket. This weight of fission fragments causes a total integrated dose of less than 0.00013 rad to the crew, which is well below acceptable levels. Author

N71-33657*# United Aircraft Corp., East Hartford, Conn. Research Labs.
**INVESTIGATION OF NUCLEAR LIGHT BULB STARTUP AND ENGINE DYNAMICS**
Thomas S. Latham, Harold E. Bauer, and Richard J. Rodgers *In* Florida Univ. Res. on Uranium Plasmas and Their Technol. Appl. 1971 p 285–290 refs (See N71-33626 20-22)
(Contracts NASw-847; SNPC-70)
Avail: SOD $3.75; NTIS CSCL 18E

Analytical studies were conducted to determine the operating conditions of a nuclear light bulb engine during startup and the transient response of the engine to various perturbations at the nominal full-power operating level. The dynamic characteristics of the uncontrolled nuclear light bulb engine at full-power operating conditions are described. The variations of critical mass and fuel and moderator average temperatures during engine startup are also discussed. Author

N71-33658*# United Aircraft Corp., East Hartford, Conn. Research Labs.
**CALCULATIONS OF THE SPECTRAL EMISSION FROM THE FUEL REGION OF A NUCLEAR LIGHT BULB REACTOR**
Nicholas L. Krascella *In* Florida Univ. Res. on Uranium Plasmas and Their Technol. Appl. 1971 p 291–299 refs (See N71-33626 20-22)
(Contracts NASw-847; SNPC-70)
Avail: SOD $3.75; NTIS CSCL 18E

A program was formulated to determine the effects of: (1) changes in the heavy-atom model parameters, (2) addition of a seed gas, and (3) inclusion of reflective end walls on the spectral radiation emitted from the fuel region of a nuclear light bulb engine. The iterative procedure, unit cavity configuration and conditions, and a description of the cases used in the program are summarized as well as calculated temperature distributions near the fuel edge. It was found that the radiative flux spectral distribution differs appreciably from that of a blackbody at a temperature of 15,000 R; and that the addition of a seed gas such as hydrogen tends to attenuate the radiation emitted in the ultraviolet region of the spectrum. The use of end walls with reflective coatings such as aluminum tends to shift the spectral distribution of radiated energy to higher wave numbers for a given total flux emitted from the fuel. J.M.

N71-33659*# United Aircraft Corp., East Hartford, Conn. Research Labs.
**DEVELOPMENT OF A HIGH INTENSITY RF RADIANT ENERGY SOURCE FOR SIMULATING THE THERMAL ENVIRONMENT OF THE NUCLEAR LIGHT BULB REACTOR**

Ward C. Roman *In* Florida Univ. Res. on Uranium Plasmas and Their Technol. Appl. 1971 p 301–306 refs (See N71-33626 20-22)
(Contracts NASw-847; SNPC-70)
Avail: SOD $3.75; NTIS CSCL 18E

A radiant energy source design is reviewed for use in simulating a vortex-stabilized nuclear light bulb engine. The source geometry and flow pattern of the high-power, high-pressure RF plasma are outlined. The 1.2 MW RF induction heater power source, resonator section, and fiber optic scanning system for determining the discharge diameter, shape, and stability are described. The effects of varying discharge power on the discharge geometry; the radial distribution of temperature variations of discharge power density and radiant energy flux with discharge power; and chamber pressure effects on the fraction of power radiated are shown graphically. J.M.

**N71-33660*#** United Aircraft Corp., East Hartford, Conn. Research Labs.
**EXPERIMENTS FOR SIMULATING THE ABSORPTION OF THERMAL RADIATION IN THE PROPELLANT DUCT OF A NUCLEAR LIGHT BULB REACTOR**
John F. Klein *In* Florida Univ. Res. on Uranium Plasmas and Their Technol. Appl. 1971 p 307–312 refs (See N71-33626 20-22)
(Contracts NASw-847; SNPC-70
Avail: SOD $3.75; NTIS CSCL 18E

Experiments to simulate the absorption of thermal radiation in the propellant duct of a nuclear light bulb reactor are described. The experimental objectives include (1) development of methods for injecting solid particle seeds into a simulated propellant stream, (2) the effective usage of buffer layers to prevent coating of the duct walls, and (3) the absorption of a large percentage of incident radiation from a high-intensity light source in a simulated propellant stream. A discussion of the results obtained in initial experiments is presented. Author

**N71-33661*#** Avco-Everett Research Lab., Everett, Mass.
**MHD POWER GENERATION: STATE OF THE ART AND PROSPECTS FOR ADVANCED NUCLEAR APPLICATIONS**
Richard J. Rosa *In* Florida Univ. Res. on Uranium Plasmas and Their Technol. Appl. 1971 p 315–326 refs (See N71-33626 20-22)
Avail: SOD $3.75; NTIS CSCL 18E

State-of-the-art developments in magnetohydrodynamic power generation are reviewed. Base load, emergency, and peaking power generation are included. Economic and environmental factors are considered in relation to MHD generator location. Applications of MHD generators in radiating power plants, propellant-cooled propulsion systems, and commercial industries are cited. J.M.

**N71-33662*#** Florida Univ., Gainesville.
**KINETIC STUDIES OF NUCLEAR SEEDED MHD PLASMAS**
W. H. Ellis, K. Imani, and H. G. Cofer (Westinghouse Nucl. Energy Systems) *In its* Res. on Uranium Plasmas and Their Technol. Appl. 1971 p 327–334 refs Sponsored in part by ONR (See N71-33626 20-22)
Avail: SOD $3.75; NTIS CSCL 18E

A method for studying the electron kinetics in plasmas produced by neutron irradiation of nuclear seeded noble gases is described. Experimentally determined production and loss parameters for plasmas produced by the slowing down of the reaction products of the He-3 (n,p)t reaction is reported for a range of helium gas pressures (1 to 10 atm) that is of interest for reactor coolant and MHD conversion applications. The voltage output signal amplitude of the pulsed ionization chamber (PIC) is used to measure the steady-state electron density as a function of reactor power and the measured ionization source rate (ion pairs/sec) for plasmas produced within the He-3 gas filling of the ion chamber during neutron irradiation in the thermal column of the reactor. Plasma loss coefficients can then be determined directly and the mechanisms of production and loss studied. Values reported for the second-order plasma loss coefficients obtained with electron densities measured by the PIC technique for steady-state helium plasmas as a function of pressure were in excellent agreement with theoretical predictions. Author

**N71-33663*#** National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
**THE PERFORMANCE OF HELIUM SEEDED WITH URANIUM IN A MAGNETOHYDRODYNAMIC GENERATOR**
Allen R. Bishop *In* Florida Univ. Res. on Uranium Plasmas and Their Technol. Appl. 1971 p 335–341 refs (See N71-33626 20-22)
Avail: SOD $3.75; NTIS CSCL 18E

The feasibility of using helium seeded with uranium as a working fluid in an MHD generator is discussed. Nonequilibrium ionization of the seed (uranium), including losses due to electrothermal instabilities, is examined over a range of stagnation temperatures (2000 to 4000 K), stagnation pressures (10 to 50 atm), and Mach numbers (0.5 to 1.5). The optimum mixture (for maximum power density) of helium and uranium is about 6 atoms of uranium/1,000 atoms of helium. The nonequilibrium conductivity, including instability losses, is higher than the equilibrium conductivity for the temperature range considered. The output power of a specific generator configuration is presented as a function of stagnation temperature. The helium-uranium mixture is a possible working fluid for MHD generators, although the power density is lower than those for more conventional working fluids. Author

**N71-33664*#** Georgia Inst. of Tech., Atlanta.
**GAS CORE REACTORS FOR MHD POWER SYSTEMS**
J. R. Williams and S. V. Shelton *In* Florida Univ. Res. on Uranium Plasmas and Their Technol. Appl. 1971 p 343–349 refs (See N71-33626 20-22)
Avail: SOD $3.75; NTIS CSCL 18E

The MHD generator is examined as one energy conversion device that can extract energy from a working fluid at a very high temperature. Coupled with the gas-core reactor the problem of achieving high electrical conductivities is solved by providing an extremely hot working fluid, and eliminating the high specific impulse nuclear rocket propulsion. This combined concept, with its many advantages is submitted to meet the growing demand for power without thermal pollution. E.M.C.

**N71-33665*#** Florida Univ., Gainesville.
**EFFECTS OF COLUMNAR RECOMBINATION ON CONDUCTIVITIES OF NUCLEAR SEEDED PLASMAS**
D. D. Orvis and G. R. Dalton *In its* Res. on Uranium Plasmas and Their Technol. Appl. 1971 p 351–354 refs Sponsored in part by ONR (See N71-33626 20-22)
Avail: SOD $3.75; NTIS CSCL 18E

The nonlinear effects of recombination and collective diffusion associated with nuclear-seeded ionization are investigated. There was very little collective diffusion and practically no recombination above that expected for a homogeneous plasma for the ionization of He-3 in a nuclear reactor by the (n,p) reaction. However, high pressures in the range of 20 to 100 atm increase the recombination modestly. The strong influence comes from an increase in temperature, ionization track density (as experienced with fission fragments), and recombination coefficient. It is speculated that there may be significant decreases in the charge available to uranium systems due to columnar effects. This is viewed as an increase in the effective value for the fission fragments in the gas. E.M.C.

N71-33867*# Illinois Univ., Urbana.
**CALCULATIONS OF IONIZATION-EXCITATION SOURCE RATES IN GASEOUS MEDIA IRRADIATED BY FISSION FRAGMENTS AND ALPHA PARTICLE**
P. E. Thiess and G. H. Miley *In* Florida Univ. Res. on Uranium Plasmas and Their Technol. Appl. 1971 p 369–396 refs Sponsored by AEC (See N71-33626 20-22).
Avail: SOD $3.75; NTIS CSCL 18E

The problem of predicting the spatial distribution of primary ionization-excitation source rates in a fluid being irradiated by ions from an adjoining solid fuel layer is considered. The slowing and charge loss law is used along with a transmission function previously developed to predict the energy spectra of the flux of charged particles at any plane in the fluid slab. Excitation cross sections for direct impact and secondary effects due to high-energy secondary electrons (delta rays) and recoil atoms are surveyed. A delta-ray recoil atom pseudo cross section is derived to include these secondary effects in the calculations. The flux spectra and cross sections are used to compute the spatial variation in the production rate of ionization or excitation. Detailed results are presented for the irradiation of helium in a channel bounded by fuel plates on either side. In addition to the spatial variation in the source rate of excited states produced, the total excitation produced in the channel is obtained as well as its variation with gas pressure for the case of low gas pressures. Author

N71-33873*# Battelle Memorial Inst., Columbus, Ohio.
**EFFECT OF IRRADIATION ON THE CREEP OF URANIUM DIOXIDE**
James S. Perrin and R. D. Wilson Mar. 1971 33 p refs Prepared for Argonne Natl. Lab., Ill.
(Contract W-7405-eng-92)
(BMI-1899) Avail: NTIS

The in-pile and out-of-pile creep rates of 24.48% enriched UO2 were measured in the temperature range from 1000 to 1200 C in the stress range from 1500 to 4000 psi at fission rates of 4 × 10 to the 12th power and 1.2 × 10 to the 13th power fissions/(cu cm)(sec). The in-pile creep rates are increased with respect to the out-of-pile creep rates, with the amount of enhancement increasing with increasing fission rate. At 1.2 × 10 to the 13th power fissions/(cu cm)(sec), the in-pile creep rates are greater than the out-of-pile creep rates by approximately a factor of four. Both the out-of-pile and in-pile creep rates are proportional to stress to the first power. The in-pile creep rate is strongly dependent on temperature, and has an activation energy close to that of the out-of-pile creep rate. The present results are compared with results obtained in several other recent investigations. Author (NSA)

N71-33889*# Oak Ridge National Lab., Tenn.
**SYSTEMATIC PROCEDURE FOR DETERMINING SYSTEM PARAMETERS BY PERFORMANCE INDEX MINIMIZATION**
Sen-I Chang (M.S. Thesis) May 1971 97 p refs
(Contract W-7405-eng-26)
(ORNL-TM-3311) Avail: NTIS

A study was made of the parameter space approach to determine optimum control system parameters by performance index minimization. The method which was developed can apply to high order multiple input/multiple output systems as well as to low order single input/single output systems. The controller parameters appearing in a mathematical model of the system are optimized by adjusting them in such a manner as to minimize certain integral measures of the difference between the actual and desired output response. The minimization is performed according to an optimization scheme known as the steepest descent procedure. A computer code was written for the IBM-360 which performs the calculations. Author (NSA)

N71-33890*# Idaho Nuclear Corp., Idaho Falls.
**MOXY: A DIGITAL COMPUTER CODE FOR COMPUTING CORE HEAT TRANSFER**
D. R. Evans 29 Mar. 1971 16 p refs Presented at the Meeting on New Develop. in Reactor Math. and Appl., Idaho Falls, Idaho, 29 Mar. 1971 Sponsored by AEC
(Conf-710302-2) Avail: NTIS

The program MOXY (MOdel X-Y) is one of several computer codes for the evaluation of power reactors during a loss of coolant accident (LOCA). MOXY solves the equations of the X-Y Model (in which an array of rods is represented in x-y coordinates) for a bundle of rods during a LOCA. The code uses a pseudo-three-dimensional model in which axial conduction and radiation are neglected, but in which the energy balance equation for steam traveling axially upward through the rod bundle is solved. Heat transfer by conduction, convection, and radiation and heat generation by metal-water reaction are considered. Presented are the heat transfer models used, the solution techniques for these models, and a brief evaluation of the models in which code results are compared with experimental data. Author (NSA)

N71-33701*# Argonne National Lab., Ill.
**REACTOR DEVELOPMENT PROGRAM Progress Report, Mar. 1971**
Robert B. Duffield and Robert V. Laney Mar. 1971 147 p refs
(Contract W-31-109-eng-38)
(ANL-7798) Avail: NTIS

The EBR-2 operations, fuels and materials studies, and engineering development activities are reported. Long-term high-temperature stability and radiation effects on candidate materials for LMFBR instruments were tested. Activities in the development of sodium sampling and analytical methods are described. The LMFBR fuel cycle development concentrated on the demonstration of a continuous fluid-bed denitration process for converting uranium/plutonium nitrate solutions to mixed oxide powders. Various physics experiments were conducted in the ZPPR, ZPR-6, and ZPR-9 assemblies in support of FFTF development. Analytical and experimental LMFBR safety studies are described. Environmental activities included thermal plume dispersion studies and the development of circulation models of Lake Michigan. NSA

N71-33702*# Oak Ridge National Lab., Tenn. Metals and Ceramics Div.
**PERFORMANCE CAPABILITY OF ADVANCED FUELS AND FAST BREEDER REACTORS**
T. N. Washburn and J. L. Scott May 1971 20 p refs Presented at the Conf. on Fast Reactor Fuel Element Technol., 13-15 Apr. 1971
(Contract W-7405-eng-26)
(ORNL-TM-3388) Avail: NTIS

The boundary limits of fuel performance are shown on plots of specific power (W/g) against linear power (kW/ft). For (U,Pu)O2 fuels, these boundaries form a triangle with borders of about 100 W/g minimum specific power, about 0.200 in. minimum fuel diameter, and a maximum linear power of about 12 kW/ft for the core average or about 19 kW/ft for the highest rated fuel pin. For (U,Pu)C and U,Pu)N fuels, the minimum specific power and minimum fuel diameter are the same as for the oxides. However, the higher thermal conductivity of these advanced fuels permits linear powers to about 30 kW/ft core average and about 45 kW/ft for the highest rated pin, when a sodium bond is used between the fuel and cladding to prevent excessive fuel temperatures and to provide space to accommodate fuel swelling. There is substantial economic advantage in operating fuel at these highly rated conditions, but a large amount of development work and irradiation testing must be performed with both the carbides and nitrides to permit an absolute comparison of their worth relative to oxides. Author (NSA)

**N71-33705#** Oak Ridge National Lab., Tenn.
**CYCLOTRON SIMULATION OF NEUTRON-TRANSMUTATION PRODUCED GASES IN REACTOR CLADDING AND STRUCTURAL MATERIALS**
R. T. King Apr. 1971 38 p refs Presented at the Intern. Conf. on the Use of Cyclotrons in Chem. Met. and Biol., Oxford, England, 22 Sep. 1969
(Contract W-7405-eng-26)
(ORNL-TM-3299; Conf-690924-3) Avail: NTIS

Cyclotrons were used to simulate the nearly uniform concentrations of helium produced during neutron irradiation of metals by (n alpha reactions. Gas was injected into flat sheet specimens by degrading monoenergetic ion beams with either a stationary or a rotating energy moderator of continually varying thickness. Target specimens were scanned in one and two dimensions, respectively, through these variable energy beams, producing fairly uniform concentrations of gas throughout the specimens. Thermal monitoring and beam current detection systems were employed throughout the bombardments. The effects of cyclotron-injected helium on the mechanical properties of Type 304 stainless steel, a potential cladding material for liquid metal fast breeder reactors, were investigated. Helium concentrations ranging from 0.083 to 20.0 atomic ppM severely reduced the ductility of Type 304 stainless steel in both creep and tensile tests over the ranges of strain rate and temperature for which the material fails intergranularly. Author (NSA)

**N71-33729#** Oak Ridge National Lab., Tenn. Metals and Ceramics Div.
**FUELS AND MATERIALS DEVELOPMENT PROGRAM Quarterly Progress Report, Period Ending 30 Sep. 1970**
P. Patriarca, comp and D. J. Rucker, ed. Mar. 1971 294 p refs
(Contract W-7405-eng-26)
(ORNL-4630) Avail: NTIS

Research and development of oxide fuels, advanced fuels, cladding and structural alloys, cladding fabrication, stainless steel component welding, properties of ferritic steel welds, nondestructive testing techniques, sodium corrosion studies, sodium removal and costic effects, neutron absorber materials, and uranium mononitride fuels are reported for use in fast breeder reactors. Cladding materials for space isotopic heat sources, physical and mechanical metallurgy for refractory alloys, tungsten metallurgy, fast-neutron irradiation effects on electrical insulators, fuel element fabrication, irradiation damage to aluminum and aluminum alloys, nuclear material joining, nondestructive testing, and advanced materials for steam generators are also covered. J.M.

**N71-33739*#** National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
**AN EMPIRICAL FORMULATION OF THERMIONIC CONVERTER PERFORMANCE AS A FUNCTION OF ELECTRODE EMISSION PROPERTIES**
John R. Smith and Arthur L. Smith Washington Aug. 1971 16 p refs
(NASA-TM-X-2358; E-6364) Avail: NTIS CSCL 18K

A simple empirical equation giving the emission current density in terms of the cesium atom arrival rate and the electrode surface temperature is presented in this report. The Swanson, Strayer correlation for the maximum change in work function due to cesium adsorption is compared with field-emission data for some refractory metals. Oxygen effects are discussed. Author

**N71-33741#** Oak Ridge National Lab., Tenn.
**EVALUATION OF THE USE OF PERMSELECTIVE MEMBRANES IN THE NUCLEAR INDUSTRY FOR REMOVING RADIOACTIVE XENON AND KRYPTON FROM VARIOUS OFF-GAS STREAMS Completion Report**
R. H. Rainey, W. L. Carter, and S. Blunkin Apr. 1971 58 p refs
(Contract W-7405-eng-26)
(ORNL-4522) Avail: NTIS

The effective permeabilities and separation factors of krypton, xenon, and several other gases were measured using sheets of thin silicone rubber membrane having areas as large as 2 sq ft; the pressure drop across the membrane was varied from 25 to 150 psi. Processes using such membranes were evaluated for removing radioactive noble gases from (1) the off-gas from a plant for recovering used nuclear fuels, (2) a reactor containment building following a nuclear accident and (3) the cover gas of a liquid metal fast breeder reactor (LMFBR). Radiation exposure of the membrane would not be a limiting factor in the first two applications, but the LMFBR cover gas would have to be stored to allow the short-lived gaseous nuclides to decay before it could be processed in a membrane plant. The costs of removing the noble gases from these systems were estimated. Author (NSA)

**N71-33743#** Douglas United Nuclear, Inc., Richland, Wash.
**ON OPERATION OF HALOGEN QUENCHED GEIGER-MUELLER TUBES**
L. D. Worster 4 Jun. 1970 21 p refs Sponsored by AEC
(DUN-SA-136) Avail: NTIS

The Hanford N Reactor fuel element rupture monitoring system consists of 1004 channels containing halogen quenched GM tubes for continuous monitoring of coolant samples. The system is described, and the modifications performed to correct an extremely high failure rate of the GM tubes are discussed. NSA

**N71-33750#** Idaho Nuclear Corp., Idaho Falls.
**NODAL SENSITIVITY IN MODELING A LARGE PRESSURIZED WATER REACTOR SYSTEM FOR A LOSS-OF-COOLANT ACCIDENT**
C. E. Slater and R. D. Hentzen [1970] 35 p refs Presented at Meeting on New Develop. in Reactor Mech. and Applications, Idaho Falls, Idaho, 29 Mar. 1971 Sponsored by AEC
(Conf-710302-8) Avail: NTIS

Computer codes have been developed that attempt to predict the course of a loss-of-coolant accident and the effectiveness of the emergency safety system. The extent of geometrical description used in digital computer codes for predicting the consequences of a loss-of-coolant accident in a large pressurized water reactor system has evolved from simple codes employing only three control volumes to present generation codes in which the number of control volumes or nodes is limited only by the core storage of the computer. The increased nodal description has frequently resulted in an increase in computation time. In order to avoid extensive computation time for safety analysis calculations, the geometrical description is often reduced by lumping similar system components together into a common control volume. Author (NSA)

**N71-33763#** Douglas United Nuclear, Inc., Richland, Wash.
**NOBLE GAS CONFINEMENT STUDY. VOLUME 2: CRYOGENIC POROUS MEDIA BED Final Report**
J. E. Mecca, J. D. Ludwick, and E. L. Etheridge Feb. 1971 48 p refs
(Contract AT(45-1)-1857)
(DUN-7221-Vol-2) Avail: NTIS

Trapping rare gases entrained in airstreams on a cryogenic porous medium was investigated. The adsorption bed container was 12 inches in diameter and two feet deep. Activated coconut charcoal was utilized as the adsorber. The bed contained approximately 60 pounds of the purified charcoal. The porous-media bed was constructed of aluminum and designed for an internal pressure of 25 psig. Some tests of the system were carried out. NSA

**N71-33773#** Douglas United Nuclear, Inc., Richland, Wash.
**NOBLE GAS CONFINEMENT STUDY. VOLUME 1: THE DEVELOPMENT OF A LONG-LIVED, HIGH EXPANSION FOAM FOR ENTRAPPING AIR BEARING NOBLE GAS Final Report, 1970**
J. E. Mecca, H. F. Jensen, and J. D. Ludwick Feb. 1971 85 p refs
(Contract AT(45-1)-1857)
(DUN-7221-Vol-1) Avail: NTIS

The development of a long-lived foam with many potential uses was one of the benefits realized from the noble gas confinement studies. Under the concept of long-lived, high expansion foam control, the escaping gases would be passed through a foam generator that would encapsulate the contaminated air. Radioactive decay and slow permeation of the gases through the foam would restrict the final release of the gases to within acceptable radiation control limits. The successful quest for a high expansion foam (300 to 1 expansion ratio) with the loss of internal structural integrity was described. The technique developed of blowing the foam with a flooded impingement plate, thus requiring no nozzles or devices prone to plugging, proved to be quite reliable and successful. Facilities and instrumentation were described and test data were presented for bench top tests used to evaluate some 250 foam candidates, and for large scale tests of encapsulation of 5000 cubic feet of mixtures of air and tagged noble gas. Author (NSA)

**N71-33796#** Reactive Metals, Inc., Ashtabula, Ohio.
**PRECISION EXTRUSION OF I AND E FUEL ELEMENTS, AND EXTRUSION PRESS DEVELOPMENTS Semiannual Progress Summary, Jul. – Dec. 1970**
Feb. 1971 29 p refs
(Contract AT(30-1)-1405)
(RMI-16) Avail: NTIS

Research efforts devoted to precision extrusion of I and E fuel elements are described. In other work, the 360-ton Lombard extrusion press was used to extrude tubes and wafers in support of laboratory programs. Results of research are also reported on U thermal expansion anisotropy, U oxidation, U forging, and extrusion processes. The status of programs concerned with reduction of extruded overstock and precision extrusion of Mark 30 sizes is reviewed. NSA

**N71-33834#** Oak Ridge National Lab., Tenn.
**TRANS: A ONE DIMENSIONAL FORTRAN 4 PROGRAM FOR COMPUTING THE TIME RESPONSE OF FUEL RODS TO A LOADING-UNLOADING ENVIRONMENT**
W. E. Stillman May 1971 65 p refs
(Contract W-7405-eng-26)
(ORNL-TM-3293) Avail: NTIS

The TRANS code is designed to compute transient stresses in cylindrical fuel rods. This version considers the response to thermal and pressure loads in one bilinear material with temperature-dependent properties. Plastic and creep strain increments are computed for load or time increments, respectively, and the resulting stresses determined. The stresses can be evaluated for any time in a general load cycle. Author (NSA)

**N71-33933#** Douglas United Nuclear, Inc., Richland, Wash.
**EXAMINATION OF AN INCONEL-600 TUBE FROM N REACTOR STEAM GENERATOR 6A**
W. K. Kratzer 18 Nov. 1970 18 p Sponsored by AEC
(DUN-SA-149) Avail: NTIS

Destructive examination of an Inconel 600 tube removed from N Reactor steam generator 6A showed no damage mechanism that would shorten the design life of the tubes. Intergranular corrosion appears to be progressing in the higher temperature sections of the tubing at a very slow rate as was also observed in the steam generator 4A tubes. Author (NSA)

**N71-33948#** Battelle Memorial Inst., Columbus, Ohio.
**PROGRESS ON DEVELOPMENT OF FUELS AND TECHNOLOGY FOR ADVANCED REACTORS DURING OCTOBER – DECEMBER 1970 Progress Report**
Donald L. Keller Jan. 1971 110 p refs
(Contract W-7405-eng-92)
(BMI-1898) Avail: NTIS

Activities in the development of uranium – plutonium nitride fuels for LMFBR applications, studies of high temperature fuels for advanced fast reactors, and studies of creep of reactor fuel materials are summarized. NSA

**N71-33988#** Oak Ridge National Lab., Tenn.
**EFFECT OF IODINE DECAY HEAT ON CHARCOAL ADSORBERS**
R. P. Shields and M. Siman-Tov Apr. 1971 101 p refs
(Contract W-7405-eng-26)
(ORNL-4602) Avail: NTIS

A procedure for the thermal analysis of the charcoal adsorber in a reactor containment system was developed to estimate maximum temperatures which may prevail under accident conditions. A differential equation which relates the charcoal temperature to the heat generation rate, air flow rate, and the heat parameters of air and charcoal was solved both analytically and numerically. The analytical method assumes a two inch thick slab of charcoal only and is applicable to high flow rates. A computer code was developed for numerical solution of the equation for the charcoal slab in both one and three-dimensions. The principal considerations were given to very low flows and for times soon after onset of the accident; conditions which pose the greatest threat to the charcoal. Examples are given of the application of this code to reactor off-gas charcoal adsorbers. Author (NSA)

**N71-33990#** Atomic Energy Commission, Washington, D.C. Div. of Reactor Development and Technology.
**SOVIET POWER REACTORS, 1970. REPORT OF THE UNITED STATES OF AMERICA NUCLEAR POWER REACTOR DELEGATION VISIT TO THE UNION OF SOVIET SOCIALIST REPUBLICS, 15 JUNE – 1 JULY 1970**
Aug. 1970 113 p refs
(WASH-1175) Avail: SOD $1.00

The U.S. delegation toured U.S.S.R. reactor facilities and research institutions in a reciprocal visit on nuclear power. Detailed descriptions of the reactor disciplines and reactor projects are presented from knowledge gained by discussions with technical staffs and by observations of the facilities involved. The development programs and accomplishments in sodium-cooled fast breeder and water-cooled reactors are described. NSA

**N71-34000#** Oak Ridge National Lab., Tenn.
**DESIGN OF ASYMMETRIC 4 pi SHIELDS FOR SPACE REACTORS**
W. W. Engle, Jr., R. L. Childs, and F. R. Mynatt 1 Apr. 1971 19 p refs Presented at Symp. on Natural and Manmade Radiation in Space, Las Vegas, Nev., 1 Mar. 1971
(Contract W-7405-eng-26)
(ORNL-TM-3368; Conf-710304-7) Avail: NTIS

A one dimensional shield optimization program based on the method of discrete ordinates was developed and is used to determine material thicknesses used in asymmetric 4 pi shields for space power reactors. The two dimensional discrete ordinates program DOT is used to check the design and the information generated in the DOT calculation is used as a guide in shaping the shield which may be considered a first step in two dimensional shield optimization. Author (NSA)

# 23 PHYSICS, GENERAL

Includes acoustics, cryogenics, mechanics, and optics. For astrophysics see: 30 Space Sciences. For geophysics and related information see also: 13 Geophysics; 20 Meteorology; and 29 Space Radiation.

**N71-32904#** Aerospace Corp., El Segundo, Calif. Engineering Science Operations.
**SAMPLING FUNCTIONS AND THEIR EFFECT IN OPTICAL SYSTEMS EVALUATION**
John R. Parsons 18 Dec. 1970 96 p refs
(Contract F04701-70-C-0059)
(AD-724626; TR-0059(6311)-3; SAMSO-TR-71-78) Avail: NTIS CSCL 20/6

Sampling functions and their effects in computing quantities used to evaluate optical system performance are presented. Errors generated while one is digitally computing the point spread function (PS) and the transfer function (OTF) using Fourier Transforms, as well as methods for reducing these errors, are outlined. Sufficient pupil sample points must be provided to insure against inadequate pupil description or intolerable PS aliasing. The sampling function spectrum is used to indicate why the PS sample points must be close enough together and of sufficient number to satisfy the sampling theorem and eliminate truncation errors in the OTF. Author (GRA)

**N71-32933#** Cambridge Acoustical Associates, Inc., Mass.
**SOUND PROPAGATION IN SHADOW ZONES**
David A. Sachs Feb. 1971 69 p refs
(Contract N00014-70-C-0080)
(AD-724349; CAA-U-365-222) Avail: NTIS CSCL 20/1

Sound propagation in stratified media such as the ocean is conveniently analyzed using geometric (ray) acoustics. In this theory, sound energy propagates along curved trajectories, the rays. However, in regions behind certain curves called caustics, formed from envelopes of intersecting rays, no rays penetrate and ray theory predicts no sound disturbance whatever. Yet experimental observations indicate not only detectable but significant signals in these shadow zones. The author extends traditional ray theory into the shadow zone by admitting complex-valued solutions to the equations of ray acoustics. The theory is applicable to realistic sound speed profiles and encompasses both transient as well as harmonic sound sources. In the steady-state case, the sound field in the shadow is found to decay exponentially with frequency and with distance from the caustic. Within its approximations, the theory appears to be in agreement with experimental results. Author (GRA)

**N71-33042#** Texas Univ., Austin. Applied Research Labs.
**SPECTRA, COVARIANCE FUNCTIONS, AND ASSOCIATED STATISTICS OF UNDERWATER ACOUSTIC SCATTERING FROM LAKE SURFACE**
Terry D. Plemons 3 Apr. 1971 207 p refs
(Contracts N00024-71-C-1185; N00024-70-C-1247)
(AD-724335; ARL-TR-71-17) Avail: NTIS CSCL 20/1

A statistical analysis using ensemble averages is made of reverberation data obtained from the wind-driven surface of a fresh water lake. To produce the reverberation, gated FM and cw pulses are transmitted to insonify the scattering surface. The center frequency of each transmitted signal is 110 kHz. Two pulse durations, of 0.1 msec and 1.0 msec, are used in the cw experiment. The bandwidth of the FM signals, whose pulse durations are 1.25 msec, is 9.6 kHz. The transmitter and receiver are located at essentially the same place (R at T); i.e., the operation is monostatic. In the cw experiment the grazing angle is 22 deg and in the FM experiment the grazing angle is 0 deg. Author (GRA)

**N71-33161#** Istituto Superiore di Sanita, Rome (Italy). Lab. di Fisica.
**THE SEMINAR AT THE PHYSICS LABORATORY [IL SEEMINARIO DEI LABORATORI DI FISICA]**
25 Jul. 1970 38 p refs In ITALIAN; ENGLISH summary
Lectures held at Rome, Jan.–Jun. 1970
(ISS-70/20) Avail: NTIS

The lectures presented at the seminar are reported. Topics discussed include: chemical and physical properties of polarized water and other liquids, electrokinetic phenomena in biology, recent theories on continental drift, and life during the Cambrian period. Transl. by F.O.S.

**N71-33188#** Rome Univ. (Italy). Inst. of Physics.
**FIELD THEORY APPROACH TO PHASE TRANSITIONS**
F. De Pasquale, D. Di Castro, and G. Jona-Lasinio 16 Dec. 1970 53 p refs Presented at the Intern. School of Phys. Course on Critical Phenomena, Erice, Italy, 27 Jul.–8 Aug. 1970 *Its* Nota Interna No. 293
Avail: NTIS

The main tools in the described field theoretical approach to phase transitions are: the renormalization group, and the analytic properties of correlation functions near the critical point. ESRO

**N71-33222*#** National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
**EXPERIMENTAL INVESTIGATIONS OF OPTICAL PROPAGATION IN ATMOSPHERIC TURBULENCE**
Michael Williams Fitzmaurice (Ph.D. Thesis–Md. Univ., 1970) Washington Aug. 1971 185 p refs
(NASA-TR-R-370; G-1004) Avail: NTIS CSCL 20F

The pertinent theoretical background and the results of a group of experiments conducted over 0.4 and 1.17 km near-ground horizontal ranges are presented. The log-amplitude variances for HeNe (0.633 micrometer) and $CO_2$ (10.6 micrometer) laser beams were found to have a ratio of 26.8, which is in close agreement with the predictions of Rytov-based spherical-wave theory. Published measurements of the saturation level of the log-amplitude variance were reviewed and several inconsistencies noted. The spatial correlation function of the irradiance field was measured and found to agree with theory. The degree of correlation between different frequency beams which had traversed the same optical path was also measured and compared to theory. The data exhibited an unacceptably large scatter and did not show the wavelength dependence. The log-normal, Rayleigh, and Rice probability distributions are discussed in terms of their applicability to irradiance statistics. Relatively weak 10.6 micrometer irradiance fluctuations were found to be equally well described by the log-normal and Rice distributions; strong fluctuations obtained at 0.488 micrometer were best described by the log-normal distribution. Author

**N71-33229*** Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
**ROTABLE ARCUATE REFLECTOR SYSTEM FOR TELESCOPES Patent**
Willard H. Wells, inventor (to NASA) Issued 28 Jun. 1971 7 p Filed 30 Dec. 1968 Sponsored by NASA
(NASA-Case-NPO-10468; US-Patent-3,588,220; US-Patent-Appl-SN-787848; US-Patent-Class-350-55; US-Patent-Class-350-310) Avail: US Patent Office CSCL 20F

A reflector system for line of sight pointing and tracking telescopes is presented. The device consists of a primary system mounted for azimuth rotation and a secondary system supported

for elevational rotation about an axis fixed relative to the surface of the segment at a point such that the secondary system is caused to describe an arc intersecting points adjacent to the foci of the primary system. The segment serves as a primary light gathering source for an optical telescope while the telescope tracks a moving point source of light. Author

**N71-33284*#** ITT Aerospace/Optical Div., Fort Wayne, Ind. Electro-Optical Operations.
**CONSTRUCTION AND TEST OF A DUAL PATCH MULTI-ELEMENT RADIANT COOLER Quarterly Report, 17 Dec. 1970–17 Mar. 1971**
R. V. Annable Mar. 1971 35 p
(Contract NAS5-21132)
(NASA-CR-121443; QR-2) Avail: NTIS CSCL 20F

All mechanical parts were fabricated, and the dual patch compartment was assembled. A dual path passed sinusoidal vibration tests at 20 g's. The construction and installation of the cooler test equipment was completed. The temperatures of the cone and second (90 K) patch were recalculated to reflect small changes in the design. Sensitivity of cone designs to diffuse wall reflections were studied. Semiquantitative data on the infrared absorption of ice was used to reevaluate the effects of residual outgassing. Experimental measurements confirm theoretical predictions on the radiative decoupling between low-emissivity surfaces. Author

**N71-33290#** Aeronautical Research Inst. of Sweden, Stockholm.
**A SIMPLE MEASURING PROCEDURE FOR VAPOR DROPLETS ACCORDING TO SIZE AND MASS**
J. K. Kaeufl 1971 55 p In SWEDEN; ENGLISH summary
(FFA-Memo-77) Avail: NTIS

Calibration of spray nozzles for water with respect to the drop sizes produced is often needed. A method for the measurement of the spectrum of drop sizes has been developed. The method uses a sedimentation procedure of the drops sprayed on the surface of a kerosene tank. With the transparent tank in a dark room, a horizontal sheet of light is located at a certain depth. The diffuse reflected light from drops in the light sheet can be used as a measure on the mass of water passing the sheet and by relating the momentary values to the time integral between zero before and zero after the percentual part of drops with a certain size can be determined. The accuracy of the method is studied and comparison made with other methods. The method is suitable for drop sizes 5 micron to 1000 micron and gives at 150 micron an accuracy of + or −2.5%. Author

**N71-33291** Technische Hogeschool, Eindhoven (Netherlands).
**CURRENT AMPLIFICATION IN BREAKDOWN OF TOWNSEND DISCHARGES IN NEON AND NEON-ARGON MIXTURES [STROOMVERSTERKING EN DOORSLAG VAN TOWNSENDONTLADINGEN IN NEON EN NEON-ARGON MENGSELS]**
Lambert Hubert Van Montfort (Ph.D. Thesis) 1971 110 p refs In DUTCH; ENGLISH summary
Avail: NTIS

The current amplification in a Townsend discharge is determined by the combination of primary ionization of the gas and secondary ionization processes at the cathode. Three different measurement methods for Townsend discharges are discussed and used to determine the primary ionization coefficient. Results from a radiant flux measurement method indicate that the primary ionization coefficient is independent of the gas pressure below 250 torr. Calculations concerning the influence of gas pressure and electrode distance on ionization of Penning mixtures show that resonance atoms contribute to the Penning effect by direct ionization and by in ionization via an intermediate metastable state, in addition to the direct contribution of metastable atoms to ionization. Current and radiant flux measurements for a neon/argon mixture show that the primary ionization coefficient decreases with increasing pressure and that the secondary ionization coefficient at breakdown increases slightly with increasing pressure. Author

**N71-33315#** Catholic Univ. of America, Washington, D.C. Inst. of Ocean Science and Engineering.
**A LITERATURE SURVEY OF NOISE POLLUTION**
H. H. Shih Mar. 1971 97 p refs
(Contract N00014-69-A-0432)
(AD-724344; Rept-71-5) Avail: NTIS CSCL 20/1

Physically, noise is a complex sound that has little or no periodicity. However, the essential characteristic of noise is its undesirability. Thus, noise can be defined as any annoying or unwanted sound. In recent years, the rapid increase of noise level in our environment has become a national public health hazard. Noise affects mans state of mental, physical, and social well-being. The problem forms a special type of air pollution. Noise study is a rather new subject among other branches of science. The transition from art to near-science started from before the World War II. The work is an attempt to arrive at an understanding of the general situation on the problem of noise. The survey consists of four major parts: the present status of noise pollution, its sources, its effects, and the control. Many urgent research needs are also identified. Finally, lists of terminology and bibliography relating to noise pollution problems are provided. Author (GRA)

**N71-33376*#** Radio Corp. of American, Princeton, N.J.
**PHOTOCHROMIC MATERIALS RESEARCH FOR OPTICAL DISPLAY Final Report, 1 Jun. 1970–31 Jan. 1971**
R. C. Duncan May 1971 73 p refs
(Contract NAS5-10335)
(NASA-CR-121453) Avail: NTIS CSCL 20F

Extensive quantitative and comparative evaluations of a broad range of inorganic photochromic materials that offer potential as information input planes for coherent optical data processing applications were carried out. The evaluated samples comprised 17 wafers to various thicknesses of CaF2:La,Na; CaF2:Ce,Na, SrTiO3:Ni,Mo,Al; and CaTiO3:Ni,Mo. The range of wafer thicknesses included is 0.13 to 1.02 mm. The evaluation includes consideration of available wafer size and crystal quality, photochromic absorption spectra, quantitative erase mode sensitometry, time intensity reciprocity, and resolution capabilities. Most of the evaluative tests were carried out in the erase mode using coherent 5145 A argon laser radiation. The results of these tests are presented and summarized in numerous graphs, tables, and photographs distributed throughout the text and in three appendices. Author

**N71-33384#** Eidgenoessische Technische Hochschule, Zurich (Switzerland).
**THE ANGLE EIKONOMETRY FOR COMPLEX OPTICAL SYSTEMS [DAS WINKELEIKONAL FUER ZUSAMMENGESETZTE OPTISCHE SYSTEME]**
Jakob Jutz (Ph.D. Thesis) 1970 140 p refs In GERMAN
Avail: NTIS

The imaging properties of an optical system are described by angular eikonometry representing beam direction functions in objective and image spaces. This eikonometric function is used to formulate adequate functional conditions to describe an optical system where one or two planes are imaged sharply and clearly onto one plane. Example calculations using angular eikonometry for rotation-symmetrical systems with Schwarzschild optics are considered. Transl. by G.G.

**N71-33425#** Air Force Cambridge Research Labs., Bedford, Mass.
**ASPEN INTERNATIONAL CONFERENCE ON FOURIER**

**SPECTROSCOPY, 1970**
George A. Vanasse, A. T. Stair, Jr., and Doran J. Baker, eds. 5 Jan. 1971 165 p refs Conf. held at Aspen, Colo., 16–20 Mar. 1970
(AD-724100; AFCRL-71-0019; AFCRL-SR-114) Avail: NTIS CSCL 20/6

The report constitutes the proceedings of the Aspen International Conference on Fourier Spectroscopy. The tutorial lectures, which are also included in the proceedings, were intended to bring the participants to the point where the invited and contributed papers would be beneficial to all. These lectures began with a mathematical introduction and with a comprehensive outline of the technique of Fourier spectroscopy. The following specific topics were treated in more detail: signal-to-noise considerations, interferometers for Fourier spectroscopy, double-beaming techniques, refractometry, data handling and processing, and finally a speculative digression on the impact new developments in sources and detectors might have on Fourier spectroscopy. The invited and contributed papers ran the gamut of high and low resolving power instrumentation and results; from resolutions of tens of wavenumbers to thousandths of wavenumbers. The topics covered included new instrumentation, new data handling and analysis techniques, advantages of Fourier techniques as demonstrated by recent results, theoretical considerations on general problems associated with the technique, and applications of the technique under adverse conditions. Finally, it was decided to accept papers on multiplex techniques other than Fourier and/or interferometric. These papers were presented in the last session of the meeting and are also included in this volume. Author (GRA)

**N71-33499*#** National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
**AN INVESTIGATION OF ATMOSPHERIC TURBULENCE BY STELLAR OBSERVATIONS**
Jack Lytle Bufton (Ph.D. Thesis – Md. Univ., College Park) Aug. 1971 177 p refs
(NASA-TR-R-369; G-1003) Avail: NTIS CSCL 20F

The optical effects of atmospheric turbulence on stellar observation were investigated. Optical statistics were expressed in terms of a refractive index structure constant which pertained to the strength of turbulence along the optical path. Data were presented on stellar and meteorological observations made between fall 1968 and spring 1969 with a 0.152 meter diameter refracting telescope. Data were recorded simultaneously on the three parameters of image intensity, motion, and size. The data were interpreted in terms of the theory and were used to estimate strength of turbulence. A series of profiles for a refractive index structure constant along the vertical path were presented. These were constructed using stellar data to calculate parameters of a model. Author

**N71-33563*#** National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
**WETTING DYNAMICS OF EVAPORATING DROPS ON VARIOUS SURFACES**
F. F. Simon and Y. Y. Hsu 1971 21 p refs Presented at the 70th Natl. Meeting of the American Inst. of Chemical Engineers, Atlantic City, 29 Aug.–1 Sep. 1971
(NASA-TM-X-67913) Avail: NTIS CSCL 20M

Shape histories of water drops evaporating at room temperature on copper, Lucite, stainless steel and Teflon were recorded. The drops were observed to go through three states. In the first stage, the interface radius remained constant while the contact angle reduced with decreasing volume, until the receding angle is reached. In the second stage, the radius decreased almost linearly with time while the contact angle remained a little less than the receding angle. In the third stage, both radius and contact angle reduced rapidly. The relative length of each stage is determined by the type of surface. For a highly wettable surface, stage 1 dominated, for a very nonwettable surface, stage 2 dominated. An analysis is presented enabling the prediction of shape history of a drop provided the evaporation rate and flow resistance over the surface are given. Author

**N71-33560*#** Dynatech Corp., Cambridge, Mass.
**AN EXPERIMENTAL STUDY OF NOISE ATTENUATION BY LIQUID INJECTION**
Lewis A. Maroti and Gerald B. Gilbert Mar. 1971 52 p refs (Contract NAS1-9809)
(NASA-CR-111905) Avail: NTIS CSCL 20A

The objective of this investigation was to define the magnitude of noise attenuation which can be produced by injecting evaporating droplets into a subsonic duct flow. This flow model, which is simple compared to the actual flow in an axial compressor or fan, was selected as a first step to explore the potential of noise attenuation by liquid injection. The reduction of noise generation by liquid injection was not studied; this must await testing on a fan or compressor. Author

**N71-33571** Maryland Univ., College Park.
**AN INVESTIGATION OF THE ELECTROMAGNETIC INTERACTION OF SUPERCONDUCTORS NEAR T SUB c USING TRANSVERSE HYPERSOUND**
Edward A. Page (Ph.D. Thesis) 1969 81 p
Avail: Univ. Microfilms Order No. 70-15508

The attenuation of transverse hypersonic waves was measured in a superconductor, single crystal tin, near the superconducting transition temperature T sub c. Measurements of the temperature and frequency dependence, at 395, 1016, and 1335 MHz, were in remarkable agreement with the theoretical predictions. These are the first ultrasonic measurements to exhibit the frequency dependence of the transverse electromagnetic interaction for propagating waves. Dissert. Abstr.

**N71-33609** Catholic Univ. of America, Washington, D.C.
**ACOUSTIC RADIATION FROM MULTIPLE SURFACES**
Ronald New (Ph.D. Thesis) 1970 91 p
Avail: Univ. Microfilms Order No. 70-17416

A significant part of the current research effort in Acoustic Radiation Theory is concerned with transducer arrays and the effects of the interaction therein. There exist two broad subclasses of the total problem: (1) one or more vibrating elements on a single common surface (baffle) and (2) one or more vibrating elements on multiple surfaces. Problems within the 1st sub-class have been treated extensively. Few solutions exist for problems within the 2nd sub-class and those that do are very restricted. This dissertation seeks to extend the list of analytic developments to include solutions to certain multiple surface problems. A formal solution to the problem of two vibrating spheres using the method of Green's functions was obtained. The extension to N vibrating spheres, of arbitrary radii and location, follows and was obtained directly from the two sphere problem. It was shown that the method is generally applicable to the N-body problem if the individual body shapes conform to a separable coordinate system and the total field can be made to satisfy the Sommerfeld radiation condition. However, practical limitations to problems involving separable geometries are shown to exist. To demonstrate the practicality of the method, the problem of two pulsating spheres was carried through to completion. Numerical results were obtained which demonstrate the effects of interaction (scattering) on the near and far-field pressure and the radiation impedance of one sphere in the presence of the other. Comparisons were shown between these theoretically derived results and those obtained from experimental studies. Dissert. Abstr.

**N71-33610#** Council for Scientific and Industrial Research, Pretoria (South Africa).

**ELECTRO-BRIGHTENING AND CHEMICAL BRIGHTENING [BRILLANTAGE ELECTROLYTIQUE ET BRILLANTAGE CHIMIQUE]**

G. Bacquias Sep. 1969 11 p Transl. into ENGLISH from Galvano (Paris), no. 360, 1967 p 43-46
Avail: NTIS

The processes of electro-brightening and chemical brightening are compared. Surface preparation, choice of materials, types of solutions, and operating conditions were discussed. J.G.M.

**N71-33624*#** Translation Consultants, Ltd., Arlington, Va.
**A SYSTEM OF HIGH-CONTRAST DIFFRACTION FRINGES [UN SYSTEME DE FRANGES DE DIFFRACTION A GRAND CONTRASTE]**

A. Kastler Washington NASA Sep. 1971 11 p refs Transl. into ENGLISH from Rev. d'Optique (Paris), v. 29, no. 6, Jun. 1950 p 307-314
(Contract NASw-2038)
(NASA-TT-F-13794) Avail: NTIS CSCL 20F

By juxtaposing two half-wave plates whose neutral lines intersect through their rectilinear edges, there is established between the vibrations of a wave plane on either side of the line of separation a difference in operation amounting to a half-wave length. The overlapping of luminous vibrations beyond this wave plane produces a system of fringes whose maximum and minimum values are located at the same places as those of a rectilinear screen edge, but the new fringes are much more contrasted than the fringes of the half-plane. The fringes extend symmetrically on either side of a completely dark central fringe located in the plane projected by the line of separation of the two plates in the direction of the luminous beams. The distribution of intensity in these fringes is directly proportional to the sum of the squares of the two Fresnel integrals, and the amplitude and the phase of the luminous vibration are depicted by the vector connecting the origin (center of symmetry) of the Cornu spiral at the figurative point of this spiral. By the juxtaposition of various half-wave plates with crossed neutral lines, it is possible to produce such things as zoned networks and image apodizers. Author

**N71-33697*#** National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
**LIQUID/SOLID ON EVAPORATIVE FLUID METASTABLE LEIDENFROST STATES**

R. C. Hendricks and S. A. Ohm [1971] 9 p refs Presented at 13th Intern. Congr. of Refrigeration, Washington, D.C., 27 Aug.-3 Sep. 1971
(NASA-TM-X-67897) Avail: NTIS CSCL 20L

Liquid or solid spheres levitated in film boiling on an evaporative liquid were found to follow a metastable Leidenfrost locus similar to that established for evaporative liquids floating on metallic surfaces. Estimates of the time a drop should remain in film boiling are much less than the recorded floating times; consequently, the drop appears to be in the metastable film boiling states. One oil/solid sphere floated on liquid nitrogen over 10 minutes. However, the maximum levitation time was not established. On the other hand, surface protrusions and cracks on the floating spheres appeared to trigger an early termination of film boiling. Premature transition was noted for water/ice and carbon tetrachloride/solid on liquid nitrogen. The metastable state can be terminated in one of the following heat transfer regimes: (1) transition boiling, where intermittent liquid-vapor contact caused the sphere to gyrate wildly and sink; (2) nucleate boiling, bubbles appeared as the sphere sank; (3) conduction and convection, where the sphere was wetted and sank. Author

**N71-33751#** Rutgers Univ., New Brunswick, N.J. Dept. of Physics.
**CRITICAL ATTENUATION OF SOUND AT MAGNETIC PHASE TRANSITIONS**

Richard James Polline (Ph.D. Thesis) Jun. 1970 159 p refs
Sponsored in part by NSF
Avail: NTIS

Experimental results on critical velocity and attenuation changes are presented and discussed for longitudinal and shear ultrasound. Critical velocity changes show uniform behavior for all substances, a frequency independent and a weak temperature dependent effect; the critical attenuation changes show a wide variety of behavior for different materials. A given substance can be characterized by the following physical parameters: spin structure (ferro- or antiferromagnet), magnetic anisotropy, and range of spin interaction. Ultrasonic attenuation measurements are made over the frequency range 10-230 MHz in the rare earth metals Gd, Tb, Dy, Ho, in the insulators EuO, MnF2, RbMnF3, and in Cr, in order to determine the nature of the attenuation singularity at the magnetic transition temperature. Longitudinal waves couple through the volume magnetostrictive interaction, while shear waves couple to the linear magnetostriction. Author

**N71-33755#** Yale Univ., New Haven, Conn.
**THE MAGNETIC PROPERTIES OF THE RARE EARTH HYDROXIDES**

Carmen Anthony Catanese (Ph.D. Thesis) 1970 154 p refs
Sponsored in part by AEC and NSF
Avail: NTIS

The magnetic properties of Gd-, Tb-, Dy-, and Ho(OH)3 were studied in order to obtain a picture of the interactions and ordering mechanisms in these systems. Both the dipolar and nondipolar interactions in Gd(OH)3 were determined and all of the measured low temperature properties, including the antiferromagnetic ordering at 0.94 K, were explained on the basis of these interactions. The Tb(OH)3 was found to be a remarkably good approximation to an ideal Ising system at low temperatures; the ferromagnetic transition at 3.71 K in this system was explained on the basis of dipolar interactions only, but nondipolar antiferromagnetic interactions were shown to be appreciable. Both Dy- and Ho(OH)3 were also found to be dipolar-dominated ferromagnets at low temperatures. The properties of these systems above 4 K were shown to be dominated by low-lying excited states, and some estimates of the position of these states is made. A rough estimate of the order of magnitude of nondipolar interactions in these two systems was obtained. Author

**N71-33926** Illinois Inst. of Tech., Chicago.
**SUBHARMONIC ROTOR INSTABILITY DUE TO ELASTIC ASYMMETRY**

Edward Emil Messal (Ph.D. Thesis) 1970 104 p
Avail: Univ. Microfilms Order No. 70-17254

The lateral motion of a central disk on a vertical asymmetric shaft was examined theoretically and experimentally. The top bearing support is rigid and the bottom bearing has an asymmetric elastic support. The equations of motion are two coupled Hill equations with periodic coefficients having frequencies of twice and four times the driving frequency. The terms dependent on four times the driving frequency are a new aspect of elastic asymmetry in rotors, and occur because the system is statically indeterminant. The instabilities of the system were studied by a perturbation-variation method proposed by Hsu, and a second order analysis had to be made in order to retain the small new terms in the equations of motion. Dissert. Abstr.

# 24 PHYSICS, ATOMIC, MOLECULAR, AND NUCLEAR

Includes atomic, molecular, and nuclear physics. For applications see: 22 Nuclear Engineering. For related information see also: 29 Space Radiation.

**N71-32852#** European Space Research Inst., Frascati (Italy).
**ADIABATIC PARTICLE ORBITS IN A MAGNETIC NULL SHEET**
B. U. O. Sonnerup [1971] 29 p refs Submitted for publication
Avail: NTIS

The adiabatic theory is presented for charged particles moving in a region where the main component of the magnetic field reverses its direction. The unperturbed field configuration is onedimensional and involves two regions of uniform and opposite aagmagnetic fields separated by a reversal region of small but finite extent. The adiabatic theory is capable of describing particle orbits when gradual spatial and/or temporal field variations are added to this configuration. Several applications are given. These include orbits during a null-sheet copmpression, orbits in the sheets studied by Alfven and Speiser, and orbits in the vicinity of the magnetic null line of the so-called field-reconnection geometry.
Author (ESRO)

**N71-32900#** Australian National Univ., Canberra. Research School of Physical Sciences.
**THE 9/2(−)(514) STATE IN Re 185**
M. Evans (Manchester Univ., England), A. E. Ellis (Manchester Univ., England), J. R. Leigh (Manchester Univ., England), and J. O. Newton (Manchester Univ., England) [1970] 6 p refs
(ANU-P/518) Avail: NTIS

Gamma rays following the W-186(d,3n)Re-185 reaction were observed. Evidence is given for rotational bands based on the 5/2(+)(402) and 9/2(−)(514) states. The half life of the 9/2(−) state was measured and found to be 33 + or − 3 ns.
Author

**N71-32901#** Australian National Univ., Canberra. Dept. of Nuclear Physics.
**NOTE ON THE CROSS SECTION OF THE Mg-25(TAU,GAMMA)Si-28 REACTION**
W. F. Davidson, J. L. Black, M. R. Najam, and B. M. Spicer (Melbourne Univ., Australia) (1970) 8 p refs
(ANU-P/508) Avail: NTIS

The differential cross section for the Mg-25(tau,gamma)Si-28 reaction has been measured at E sub tau = 4.44, 6.08, 6.15, and 8.26 MeV, using a large NaI crystal spectrometer. The smallness of the observed cross section suggests that 3p-3h states play an insignificant role in explaining the intermediate structure observed above the Si-28 giant resonance in a recent study of the Si-28(gamma,neutron)Si-27 reaction.
Author

**N71-33033#** Naval Research Lab., Washington, D.C.
**TWO-PARTICLE AND TWO-HOLE STATES IN THE Pb REGION Final Report**
Thomas T. S. Kuo (State Univ. of N.Y., Stony Brook) and Gary H. Herling May 1971 82 p refs
(Contract AT(30-1)-4032)
(AD-724640; NRL-MR-2258) Avail: NTIS CSCL 20/8

Two-particle states in the nuclei 210Pb, 210Bi, 210Po, and two-hole states in the nuclei 206Pb, 206Tl, and 206Hg have been calculated, with the inclusion of core polarization, employing reaction matrix elements deduced from the Hamada-Johnston potential. Complete tables of energies and wave functions are presented.
Author (GRA)

**N71-33048#** Eidgenossische Technische Hochschule, Zurich (Switzerland).
**EXTRACTION OF A 590 MeV PROTON BEAM FROM THE SIN RINGCYCLOTRON**
Werner Joho (Ph.D. Thesis) 1970 100 p refs
(Diss-4504) Avail: NTIS

A review is given of some basic extraction systems for cyclotrons with emphasis on conventional acceleration and resonant extraction. The advantages of a ring cyclotron including a large average radius, high energy gain per turn, and ample space for extraction elements are stressed. Detailed calculations for the SIN ring cyclotron establish an extraction efficiency of about 90%. The radioactivity induced by the lost paticles gives probably an intensity limit of 100 microamperes for the extracted beam. Addition of a flattop cavity could give a monoenergetic beam and an extraction efficiency close to 100%. Special attention is given to the stability of the vertical motion since the resonances nu sub Z = 1 and nu sub r = 2 nu sub Z have to be crossed. Resonances in coupled oscillations are discussed.
Author

**N71-33095#** Istituto Superiore di Sanita, Rome (Italy). Lab di Fisica.
**STATUS OF SOME RELEVANT PROBLEMS IN NUCLEAR PHYSICS**
U. Amaldi, Jr. 30 Jun. 1970 30 p refs
(ISS-70/17) Avail: AEC Depository Libraries

The fundamental problem of nuclear physics is the calculation of the structure of nuclei from the knowledge of the nucleon−nucleon interaction. The sources of the experimental facts are reviewed and compared with the results of theory in the first part of the present contribution. In the second part the basis of the Brueckner nuclear theory is briefly outlined, and the results of recent theoretical calculations are presented. By comparing theoretical predictions and experimental data the conclusion is reached that, while the saturation properties of nuclear matter and the surface properties of nuclei are reasonably well understood, the deep single-particle states and the high-momentum components of the nuclear wave function deserve more study, both from the theoretical and the experimental points of view.
Author (NSA)

**N71-33097#** Naval Research Lab., Washington, D.C.
**REPORT OF CYCLOTRON OPERATION Final Semiannual Report, 1 Jul. −30 Dec. 1970**
May 1971 44 p
(AD-724651; NRL-MR-2240; FSAR-6) Avail: NTIS CSCL 20/7

Progress in the experimental program using the NRL Sector-Focusing Cyclotron during the period 1 July - 31 December 1970, is described. Various aspects of the developmental program associated with experimental equipment as well as development of the cyclotron are reported. The allocation of beam time to various experimental programs is included in the last section.
Author (GRA)

**N71-33118#** Nice Univ. (France). Lab. of Theoretical Physics.
**ON THE RELATIONS BETWEEN THE FEYNMAN GAS AND MULTIPERIPHERAL MODELS**
Michel Le Bellac Jun. 1971 7 p refs
(N-TH-71/4) Avail: NTIS

Results from Muller's relations between the N-particle production cross sections and the inclusive cross sections, in connection with the Feynman gas and multiperipheral models, are reviewed. It was shown that an important generating function had a Regge like behavior, and the moments mu N = $\langle (n-\langle n \rangle)N \rangle$ of the multiplicity distribution delta n/delta t in Y = lns. The role of the coupling constants in the Feynman gas model is briefly discussed. Results are in good agreement with that of Muller's.
E.H.W.

**N71-33120#** Ballistic Research Labs., Aberdeen Proving Ground, Md.
**DESIGN AND ANALYSIS OF A 10-50 MeV MONOENERGETIC POSITRON SOURCE**
William P. Bucher Jan. 1971 37 p refs
(AD-723971; BRL-1534) Avail: NTIS CSCL 20/7

Through a matrix description of the capture and acceleration of positrons by a linear accelerator with magnetic guide fields, the

optimum design and operating conditions corresponding to the maximum useful yield of positrons are determined. An expression for the differential yield is presented which is readily adaptable to various field configurations for the converter lens and to arbitrary radial distributions of positrons at the converter target.
Author (GRA)

N71-33135# Chicago Univ., Ill.
**LABORATORY OF MOLECULAR STRUCTURE AND SPECTRA Technical Report, 1 Jan. 1969 – 31 Dec. 1970**
Robert S. Mulliken, Clemens C. J. Roothaan, and Juergen Hinze 1970 390 p refs
(Contracts N00014-67-A-0285-0001; DA-31-124-ARO(D)-447; DAHC04-70-C-0037)
(AD-724337; LMSS-1969-70) Avail: NTIS CSCL 7/4

The report contains several papers on the qualitative and interpretive aspects of molecular orbital theory. Two papers are concerned with the interpretation of accurate H-F wavefunctions of small electronic molecules. Several papers give a detailed report of computed electronic and vibration rotational spectra and transition probabilities for some diatomic molecules. In addition there are a number of papers concerning high resolution UV spectroscopic studies of polyatomic molecules, and the interpretation of such spectra. In the case of some diatomics, UV spectra are more completely assigned and some bands are reinterpreted.
Author (GRA)

N71-33171*# Yale Univ., New Haven, Conn. Dept. of Physics.
**QUANTUM MECHANICAL TRANSPORT EQUATION FOR ATOMIC SYSTEMS**
Paul R. Berman 1971 59 p refs
(Grants NGR-07-004-035; AF-AFOSR-1324-67)
(NASA-CR-119724) Avail: NTIS CSCL 20H

A quantum mechanical transport equation is derived which for application to a wide range of problems involving the interaction of radiation with atoms or molecules which are also subject to collisions with perturbation atoms. The equation follows the time evolution of the macroscopic atomic density matrix elements of atoms located at classical position and moving with classical velocities. All collision kernels or rates which appear are obtained from a quantum mechanical theory and take into account the energy level variations and velocity changes of the active (emitting or absorbing) atom produced in collisions with perturbation atoms.
Author

N71-33183# Illinois Univ., Urbana. Noyes Chemical Lab.
**RAMAN BANDSHAPES AND ROTATIONAL DIFFUSION OF MOLECULES**
Stanislav Sykora 30 Apr. 1971 20 p
(Contract N00014-66-C-0010)
(AD-724330; TR-24) Avail: NTIS CSCL 7/4

It is shown that the shapes of vibrational Raman bands, measured with both parallel and crossed nicols, may serve as a tool for the study of the reorientation of rigid molecules (or molecular fragments) even if other line-broadening mechanisms are not negligible. The theory, developed for the case of isotropic media (including dense gases, liquids, and some molecular solids), holds independently of the shape of the molecules; the only requirement is that the studied band must be related to a vibration which is sufficiently localized to the individual molecule (molecular fragment). An exhaustive characterization of the reorientation properties of all second-rank molecular quantities is shown to be probably out of the reach of Raman spectroscopy except when the molecule (molecular fragment) has a high symmetry and/or a specific model of the reorientation process is accepted.
Author (GRA)

N71-33225# Australian National Univ., Canberra.
**EFFECTIVE NUCLEAR INTERACTIONS AND LEVEL PROPERTIES FOR THE LIGHTER NUCLEI IN THE 1p-SHELL**
Naresh Kumar (Ph.D. Thesis) Mar. 1970 180 p ref
(NP-18717) Avail: AEC Depository Libraries

Shell model calculations using the effective interaction approach of Talmi are reported for nuclei of mass numbers 6 to 9. Difficulty experienced in the simultaneous fitting of excitation energies of levels in these nuclei is discussed, and the possible connection of this difficulty with the deformations of Be(8) and Be(9) is indicated. After the inclusion of these deformations in a phenomenological way, the obtained effective interaction is shown to give either equally good or better agreement with the experimental data than the ones achieved by previous authors, and the resulting two-body matrix elements of the effective interaction are found to resemble the ones obtained by starting from the free two-nucleon interactions.
Author (NSA)

N71-33242# Laboratoire de Physique Theorique et des Hautes Energies, Orsay (France).
**A METHOD TO DETERMINE THE TOTAL CROSS-SECTION DELTA HYPERON NUCLEON**
G. Menessier and O. Nachtmann Jul. 1971 15 p refs
(LPTHE-71/38) Avail: NTIS

A method is described for estimating the total cross section of Delta hyperon resonance on nucleons by analyzing the final state of weak or electromagnetic Delta hyperon production on nuclei.
Author

N71-33320# Laboratoire de Physique Theorique et des Hautes Energies, Orsay (France).
**INEQUALITIES FOR STRUCTURE FUNCTIONS OF DEEP INELASTIC LEPTON-NUCLEON SCATTERING GIVING TESTS OF BASIC ALGEBRAIC STRUCTURES**
O. Nachtmann Jun. 1971 53 p refs
(LPTHE-71/29) Avail: NTIS

Inequalities for the structure functions of deep inelastic electro-and-neutrino-production on nucleons are derived from (a) the quark parton model or equivalently from a hypothesis of Fritzsch and Gell Mann on the leading light cone singularity of current commutators, and (b) the quark model with neutral gluons using current algebra techniques to the same extent as for the Callan Gross relation. Present data satisfy these inequalities, and give stringent predictions for future neutrino production experiments. On the other hand, three models with integrally charged partons, the SUB-model the Drell-Levy-Yan model and the Bjorken-Glashow model are found to be in trouble by comparison with experiment.
Author

N71-33388# Istituto Superiore di Sanita, Rome (Italy). Lab. di Fisica.
**THE STRUCTURE OF WATER AND THE THERMODYNAMICS OF AQUEOUS SOLUTIONS**
G. Nemethy (Rockefeller Univ.) 26 Oct. 1970 67 p refs
(ISS-70/26) Avail: NTIS

Lectures on water in a pure form and as a solvent are summarized. The topics discussed were: intermolecular forces; the individual water molecule and the hydrogen bond, the structures of the solid phases of water; experimental information on the structure of liquid water; theoretical models of water structure; experimental properties and theoretical models of aqueous solutions of nonpolar solutes, polar solutes, and electrolytes, and the conformational stability of biological macromolecules.
Author

N71-33389# Laboratorie de Physique Theorique et Particules Elementaires, Orsay (France).
**KINEMATIC ASPECTS OF INCLUSIVE PHENOMENOLOGY**
Edmond L. Berger (Argonne Natl. Lab., Ill.) and A. Krzywicki Jul. 1971 13 p refs

(LPTPE-71/36) Avail: NTIS

The kinematics of inclusive reactions in high energy multiparticle production phenomena is discussed. It is shown that there are two energy regimes. In the lower regime, where p < or = 100 GeV/c, mean multiplicity of produced particles may increase as a power of energy; only in the higher regime, p > or = 500 GeV/c, should the traditional behavior of mean multiplicity approximately = log s be observed. Correlations between produced secondaries are also studies. Improtant correlations are expected for purely kinematic reasons, as a reflection of d small inelasticity of through-going particles in nucleon nucleon or meson nucleon reactions. These kinematic correlations imitate correlations associated with dynamical effects. The interpretation of shapes of single-particle inclusive distributions is considered. Author

**N71-33416#** Norwegian Defence Research Establishment, Kjeller.
**ELECTRIC AND MAGNETIC FIELDS PRODUCED IN LOW ALTITUDE NUCLEAR EXPLOSIONS**
P. Thoresen Mar. 1970 103 p refs
(NORE-57) Avail: NTIS

The close-in electric and magnetic fields produced by the gamma ray induced currents from a nuclear explosion are evaluated. Maxwell's equations are solved using an analytically described source function. The source function evaluated takes into account the prompt gamma ray emission from the fission, fission products and neutron reactions. Atmospheric parameters of importance for the calculations of the air conductivity are discussed and numerical results of the computed air conductivity are shown. The electric and the magnetic fields are computed using a developed analytical function for the Compton current based on the gamma ray source function. Some numerical results illustrate the time and space variation of the electric and magnetic fields. Author

**N71-33428#** Council for Scientific and Industrial Research, Pretoria (South Africa). Foreign Language Information Service.
**ATOMIC ABSORPTION ANALYSIS BY MEANS OF A GRAPHITE CELL [ABSORPTION ATOMIQUE AVEC UNE CUVETTE DE GRAPHITE]**
H. Massman Feb. 1970 20 p refs Transl. into ENGLISH from Rev. GAMS, v. 4, no. 2, 1968 p 193-201
(Ref-835) Avail: NTIS

A heated graphite cell was used for atomic absorption analysis in place of the customary flame. The samples were evaporated by electrical resistance heating of the cell in an inert atmosphere. The time necessary to completely evaporate the sample was only a few seconds. The sensitivity of the method was much higher than atomic absorption analysis with a flame, but the precision of the method was less. The standard deviations were between 4 and 12%. When an internal standard was used better precision was reached. Author

**N71-33431#** Los Alamos Scientific Lab., N.Mex.
**THE MEDIUM-ENERGY PHYSICS PROGRAM Quarterly Status Report, Period Ending 31 Jan. 1971**
Mar. 1971 56 p refs
(Contract W-7405-eng-36)
(LA-4639) Avail: NTIS

Research and development progress is summarized. Topics include accelerator structures, RF power systems, accelerator control and instrumentation, accelerator physics, experimental area, LAMPF scheduling and facility construction, and the LAMPF users group. Also, physics research is discussed including the pion-absorption experiment, medical applications of muonic X-ray, the electron prototype accelerator, and multiwire proportional counter development. NSA

**N71-33444*#** National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.

**TILT ANGLE DEPENDENCE OF 10 MeV PROTON CUTOFF LATITUDES**
James L. Burch (Military Acad.) Aug. 1971 19 p refs Submitted for publication
(NASA-TM-X-65678; X-646-71-344) Avail: NTIS CSCL 20H

Trajectories of 10 Mev protons in an image dipole model magnetosphere were numerically integrated for several values of the tilt of the geomagnetic dipole. In order to obtain a closed magnetic field model it was necessary to tilt the image dipole toward the earth for northern hemisphere summer conditions. Significant variations in cut-off latitude with changing tilt angle were found only near 0600 and 1600 local times with cutoff latitudes closest to the pole for the zero tilt condition. Author

**N71-33487** Michigan Univ., Ann Arbor.
**THE STRUCTURE OF REGGE RESIDUE AND TRAJECTORY FUNCTIONS**
Donald Manning LeVine (Ph.D. Thesis) 1969 142 p
Avail: Univ. Microfilms Order No. 70-14580

Using results of both theoretical and phenomenological arguments, a review and critique is made of the properties of Regge trajectory and residue functions. The major conclusion reached is that very little is known for certain about the structure of these functions. Their possible forms and structures are then compared by determining how several different sets of these residue and/or trajectories fit the experimental data for the reaction pion(+) proton yields neutral omega meson N* + +. A single rho exchange insufficient to explain the data is found. While unable to distinguish between the addition of more exchanges (e.g., the B-meson) and the inclusion of Regge cuts, it is concluded that if Regge cuts are assumed to contribute significantly to the reaction, the residue function must be nonzero at the nonsense wrong-signature point alpha sub rho = 0, contrary to several theoretical arguments. Dissert. Abstr.

**N71-33488** New York Univ., N.Y.
**THEORY OF THE PHONON SPECTRUM OF V3Si**
Barry M. Klein (Ph.D. Thesis) 1969 235 p
Avail: Univ. Microfilms Order No. 70-16079

A theoretical investigation is presented of the phonon spectrum of V3Si based on a physically motivated model of the conduction electron bands. The calculations are performed within the adiabatic-harmonic approximation for the electron lattice system. The long-range forces in the V3Si lattice are accounted for by using a Coulomb potential screened by the electronic dielectric tensor which is calculated in the self-consistent field approximation. The resulting screening tensor is further simplified when the approximation is invoked of replacing the screening tensor by a diagonal tensor. It is shown that this approximation is equivalent to constraining the kernel coupling of the induced electronic potential to the electron-lattice potential to depend only on the separation of the source and field points. Dissert. Abstr.

**N71-33489#** Interuniversitair Reactor Instituut, Delft (Netherlands).
**COBALT AND TANTALUM TRACERS MEASURED BY ACTIVATION ANALYSIS IN SEDIMENT TRANSPORT STUDIES**
A. J. de Groot, E. Allersma, M. de Bruin, and J. P. W. Houtman Repr. from paper of the Symp. Isotope Hydrol. 1970, Vienna, 9-13 Mar. 1970
(IRI-133-70-06) Avail: NTIS

Principles of research to be used in investigating the origin and transport of fine grained sediments in rivers and sea arms in connection with siltation problems of harbors and navigation channels are proposed. The selection and successful application of tracers that can be measured by activation analysis depends on the sentivity of detection, the natural occurrence of the relevant

elements in the sediments under investigation and the fixation capacity of the tracer to the various grain size fractions. The irradiation of Co and Ta with thermal neutrons gives rise to a very sensitive evaluation of the original elements present. The fixation process of Co is restricted to sediments with special characteristics; Ta, however, can adhere tightly to any sediment. Tantalum also has the advantage that its natural content in sediments is very low. Large quantities (several per cent by weight) can adhere to the sediment without changing the sedimentation properties to an appreciable extent. Hardly any losses occur during leaching experiments simulating natural conditions. A detailed treatment is given of the chemical aspects of the method, including the behavior of the elements used in the light of the general environmental processes of sediment constituents in deltaic systems, and the scope and limits of the method are discussed. Author

**N71-33522** Florida State Univ., Tallahassee.
**ON THE UNIQUENESS OF THE REAL OPTICAL POTENTIAL**
Brant Dennee Watson (Ph.D. Thesis) 1970 125 p
Avail: Univ. Microfilms Order No. 70-16353

Alpha particles were elastically scattered from Ge-70, Zr-90, Ag-107, and Ce-140 at incident energies from approximately 0.6 to 1.2 times the classical Coulomb barrier height for each in an effort to resolve the problem of discrete real well depth ambiguities found in optical model analyses reported previously. Consistently good fits were obtained to angular distributions and excitation functions for each nucleus. For three of the nuclei only one pair of real (U) and volume imaginary (W) potentials was found. However, the real well depth for Zr-90 showed a slight energy dependence. Extensive grid searches on U and W were carried out for a representative highest energy angular distribution for each nucleus. Contours of constant chi squared were plotted and clearly indicate the absence of other solutions for the real well depth U. Since ambiguities were expected to occur at these high energies, further calculations were performed in which the effect of absorption (W) was more generally explored. The usefulness of Robson's method was found to be limited to cases where the absorption required by the data is either small with respect to U or is ineffective. Dissert. Abstr.

**N71-33523** Yale Univ., New Haven, Conn.
**THEORY OF ATOMIC STRUCTURE INCLUDING ELECTRON CORRELATION**
Iskender Oekuez (Ph.D. Thesis) 1969 145 p
Avail: Univ. Microfilms Order No. 70-2781

ANN-body theory of correlation effects for excited states of atoms, applicable also to ground states, is presented. The method is applied to 113 species arising from configurations of the type 1s2 2sn 2pm (n=0,1,2; m = 0,1,...,6). The types of correlations indicated by the theory are evaluated and analysed. They are then used for predictions of energies and related quantities such as electron affinities, intermultiplet separations, energies of excited states of negative ions, excitation energies and term splitting ratios of excited configurations. Transformation properties of pair correlation functions and energies among various orbital pair descriptions are investigated. Dissert. Abstr.

**N71-33524** Maryland Univ., College Park.
**LONG RANGE ELECTROMAGNETIC INTERACTIONS BETWEEN NEUTRAL SYSTEMS**
Michael Louis O'Carroll (Ph.D. Thesis) 1969 108 p
Avail: Univ. Microfilms Order No. 70-15377

A number of topics in the theory of the long range electromagnetic interaction between neutral particles are studied. An analytic formula is derived for the Van der Waals constant. Using the methods of covariant dispersion theory, a proof of the universality of the asymptotic R(−7) behavior of the two-photon exchange potential, V sub 2 gamma (R), is presented which makes no reference to off-shell quantities. A simple formula for the electric-electric part, V(EE)(R), of V sub 2 gamma(R) is proposed which gives excellent agreement with theoretical calculations of V(EE). The electromagnetic vertex operator for a system of arbitrary spin is employed to study the spin-averaged one photon exchange potential, acting between neutral systems of arbitrary spin. This approach is then extended to study the asymptotic, large R, spin-averaged two-photon exchange potential. This result is then generalized to the case of arbitrary spin for both systems. Dissert. Abstr.

**N71-33531#** Northeastern Univ., Boston, Mass. Dept. of Physics.
**OPTICAL PROPERTIES OF PHONON SYSTEMS WITH DISORDERED FORCE CONSTANTS, WITH APPLICATION TO NH4Cl**
James M. Loveluck and Jeffrey B. Sokoloff Jun. 1971 32 p refs
(NUB-2087) Avail: NTIS

A theory of systems with substitutional disorder was presented. The theory treats off diagonal disorder and is thus suitable for application to systems with disordered force constants. Particular consideration was given to NH4Cl which has a disordered phase in which the force constants between positive NH4 ions are disordered because there are two equally probable orientations of a positive NH4 ion within a unit cell. The effect of disorder on the optical absorption of such systems was studied via a calculation of the single particle Green's function. An expression for the Raman scattering cross section was also derived, and suggestions were presented for a detailed calculation of this cross section for NH4Cl, for which Cowley has published shell model calculations of the dispersion relations. Such a calculation would involve only four adjustable parameters and would be suitable for fitting optical data on NH4Cl. The theory presented was equally applicable to other systems with disordered force constants, for example disordered magnetic systems, in which the exchange interaction contributes a spin dependent force constant. Author

**N71-33532#** Oak Ridge National Lab., Tenn.
**POPOP4 LIBRARY AND CODES FOR PREPARING SECONDARY GAMMA-RAY PRODUCTION CROSS SECTIONS**
W. E. Ford, III 1 Apr. 1971 22 p refs Presented at Symp. on Natural and Manmade Radiation in Space, Las Vegas, Nev., 1 Mar. 1971
(Contract W-7405-eng-26)
(ORNL-TM-3367; Conf-710304-8) Avail: NTIS

The POPOP4 code for converting secondary gamma-radiation yield data to multigroup secondary gamma-radiation production cross sections and the POPOP4 library of secondary gamma-radiation yield data are described. Recent results in the testing of U and Fe data sets from the POPOP4 library are given. The data sets were tested by comparing calculated secondary gamma-radiation pulse-height spectra with spectra measured at the ORNL TSR-2 reactor. Author (NSA)

**N71-33550#** Ecole Polytechnique, Paris (France). Lab. de Physique.
**LARGE ANGLE HADRON SCATTERING AND DUALITY: KAON(+ OR −) PROTON, ANTIPROTON PROTON AND PROTON PROTON SCATTERING**
A. Krzywicki 7 May 1971 53 p refs
(Rept-71/19) Avail: NTIS

Invariant 4-point amplitudes satisfying the mathematical duality constraints (essentially Regge behavior and meromorphy) are considered. A simple relationship between the fixed momentum transfer (Regge) and fixed angle asymptotic, high energy behavior is established. The same reduced Regge residue functions appear

in the Regge limit and in the fixed angle asymptotic formulae (but with different arguments). The problem of determination of the contribution to the large angle scattering of those direct channel resonances which build the Regge peaks is reduced to the search of the large momentum transfer behavior of the reduced Regge residues. The theory incorporates crossing symmetry. Author

**N71-33566#** Rensselaer Polytechnic Inst., Troy, N.J.
**EUTRON AND GAMMA EMISSION FROM HIGHLY EXCITED STATES AND STATES WITH HIS SPIN Annual Progress Report, 1 Jun. 1970–31 May 1971**
Daniel Sperber Feb. 1971 9 p
(Contract AT(30-1)-3947)
(RPI-3947-13) Avail: NTIS

Analysis of isomer ratios indicates that the moments of inertia of nuclei at higher excitation have the value of the rigid body moment of inertia. A method for studying the angular distributions of particles evaporated in nuclear reactions in which states in the continuum decay into a wide range of highly excited states is described. The isomer ratios and fission lifetimes for shape isomers were calculated, with special emphasis on the reaction Am-241(n,gamma)Am-242. Estimates for the cross section for the synthesis of superheavy elements using the present generation of heavy ion accelerators were made. References to more detailed accounts of some of this work are given. NSA

**N71-33573** Arkansas Univ., Fayetteville.
**EXCITATION PROCESSES IN HELIUM ANF HYDROGEN**
Lawrence D. Weaver, Jr. (Ph.D. Thesis) 1970 122 p
Avail: Univ. Microfilms Order No. 70-17206

The absolute cross sections for the production of the He I (4 3S to 2 3P) (4713 A) and the He II (n = 4 to n = 3) (4686 A) emissions were determined for the energy range from threshold to several hundred electron volts. The experimental results for the (4 3S) excitation were compared with those of other investigators. The (4 3S to 2 3P) relative excitation function at the higher energies was found to decrease faster than those determined by other investigators. The cross sections obtained for the production of the HE II line (4686 A) were compared to the Born calculations of Lee and Lin. The experimental cross sections were about 2 to 3 times larger than those obtained from theory. The absolute cross sections for the production of the H-alpha (6563 A) and H-beta (4861 A) emissions by electron impact on molecular hydrogen were measured in the range from 20 to 400 eV. Dissert. Abstr.

**N71-33574** Connecticut Univ., Storrs.
**SMALL ANGLE DIFFERENTIAL CHARGE EXCHANGE MEASUREMENTS FOR He + ON He, Ne AND Kr IN THE LOW keV REGION**
Stephen William Nagy (Ph.D. Thesis) 1970 109 p
Avail: Univ. Microfilms Order No. 70-15547

Differential charge exchange measurements were made in the angular range of −1.00 deg to +3.00 deg at various energies ranging from 1 keV to 3 keV for He(+) on He, Ne, and Kr. The He(+) signal was recorded at angles greater than 0.50 deg while the He signal was measured over the entire angular range. The angular range was limited by the low scattered particle count rate at angles greater than 3.00 deg. Measurements were not taken below 1 keV because of the instability and low intensity of the beam while the upper limit was set by the maximum range of the accelerator. The probability of charge exchange was reported for the He(+) on He and Ne collisions and in both cases was shown to oscillate as a function of angle and was independent of energy for the range of angles and He(+) + Kr collision was the obvious lack of oscillatory structure in the count rate of the neutral signal. In addition, the three collisions were classified as symmetric or asymmetric and the charge exchange process as resonant, quasi-resonant, and non-resonant. The results of the experiment were related to the existing theories. Dissert. Abstr.

**N71-33579** New York Univ., N.Y.
**MEASUREMENT OF THE TOTAL CROSS SECTION FOR LOW ENERGY ELECTRONS ON METASTABLE ARGON**
Robert James Celotta (Ph.D. Thesis) 1969 120 p
Avail: Univ. Microfilms Order No. 70-16044

The atom beam recoil method was used to make an absolute measurement. The cross section was measured from .35 to 6.75 eV with an angular resolution of 16.1 deg in the electron polar scattering angle at an electron energy of 1 eV. A ground state argon beam was metastabilized by electron bombardment and the metastable atoms were detected by the Auger ejection of an electron from the cathode of an electron multiplier. A second electron gun, located approximately half way between the source and detector, produced the scattering electrons. Electron beams had typical energy distributions of 0.3 eV, full width at half maximum. The energy distributions of the electron beam, as well as the absolute energy of the electrons, was determined by a retarding potential technique. The absolute energy determination is believed accurate to + or − .150 eV. Dissert. Abstr.

**N71-33587#** Oak Ridge National Lab., Tenn.
**GRAPHS FOR THE ANALYSIS OF (1-3) GAMMA-GAMMA DIRECTIONAL CORRELATIONS**
A. V. Ramayya, J. H. Hamilton, P. E. Little, E. Collins, and J. J. Pinajian Apr. 1971 62 p refs Prepared jointly with Vanderbilt Univ., Nashville, Tenn.
(Contract W-7405-eng-26)
(ORNL-4619) Avail: NTIS

The gamma-gamma directional correlations on the (1−3) cascade with the intermediate transition unobserved can be used to obtain multipolarities of transitions and level spins. The correlation coefficients for a skip cascade depend also on the spins of the intermediate levels and the multipolarity of the unobserved transition as well as the spins of the upper and lower states and multipolarities of the first and third gamma rays. A set of graphs for several of the most useful cases of spins and multipolarities for the (1−3) cascades is given. NSA

**N71-33596** New York Univ., N.Y.
**DISPERSION IN LEVEL CROSSINGS AND COHERENCE NARROWING IN MERCURY RESONANCE RADIATION**
Stephen Paul Klepner (Ph.D. Thesis) 1969 197 p refs
Avail: Univ. Microfilms Order No. 70-16080

An investigation into the temperature dependence of coherence narrowing in the 6s6p P-3 sub 1 yields 6s-2 S-1 sub 0, 2537-A transition of Hg-198 was made. The work of Barrat, Omont and D'Yakonov and Perel predicts a T(−1/2) dependence which had not been previously studied experimentally. A dry cell, i.e., a resonance cell containing only mercury vapor, was prepared and the transition rate measured using the zero-field level-crossing (the Hanle effect) technique. As predicted, an increase in lifetime was observed with increasing temperature at a constant density. Line-shaped studies have also been made of the level-crossing signal. These served to confirm that the theoretical prediction by Franken of the sign of the dispersion-shaped term was in error. Dissert. Abstr.

**N71-33597** Tufts Univ., Boston, Mass.
**DYNAMIC POLARIZATION OF HYDROGEN AND FLUORINE NUCLEI IN SOLUTIONS OF SELECTED FREE RADICALS: A STUDY OF RADICAL-SOLVENT EFFECTS**
Nguyen Van Nghia (Ph.D. Thesis) 1969 256 p
Avail: Univ. Microfilms Order No. 70-17379

Dynamic polarization of protons and fluorine nuclei has been performed on four selected free radicals in solution. Aromatic and aliphatic fluorocarbon solvents are employed. Relaxation mechanisms due to the dipolar and scalar interactions between the electrons and the nuclei are investigated. The proton behavior can be explained by a pure dipole-dipole interaction governed by diffusion motions of the spin-carrying molecules, but neither the diffusion nor the sticking model proposed by Hubbard seems to be able to explain the fluorine-electron interactions. A systematic measurement of fluorine dynamic polarization enhancements as a function of magnetic field strength and radical environments shows that if appropriate combinations of the two above models are used, then a qualitative explanation can be obtained. Physical arguments are employed to justify the kinds of spectral density function which may contribute to the fluorine relaxations. The instrumentation and preparation of the samples are described in detail. Features of the instrument include: an X-band FSR spectrometer, a helix double resonance coil, an NMR detector and subsidiary equipment for these. Dissert. Abstr.

**N71-33599#** California Univ., Berkeley. Lawrence Radiation Lab.
**RELAXATION TIME MEASUREMENTS IN ELECTRON PARAMAGNETIC RESONANCE**
James J. Chang (Ph.D. Thesis) Feb. 1971 203 p refs
(Contract W-7405-eng-48)
(UCRL-19691) Avail: NTIS

The electron paramagnetic resonance (EPR) spectra VO(H2O)5(2+), obtained from vanadyl perchlorate in solutions of both ordinary water and in heavy water, was measured as a function of temperature. The linewidths in the vanadyl system are fit quite well by a combination of the relaxation theory for the bumbling of an anisotropic complex and the theory of spin-rotation interaction. The linewidths for the vanadyl ion in ordinary water solution are well fit with the glass spectrum values, and the average solution values of g = 1.9652, A = −115.9 gauss. The correlation time is consistent with a hydrodynamic radius of 3.67 A. In the deuterated system the radius is changed to 3.48 A, with the other parameters remaining the same. The small residual linewidths which have been observed for the vanadyl ion in ordinary water are also observed in the deuterated system. These residual linewidths cannot be due to hyperfine interaction with ligand protons, and must be due to terms neglected in the relaxation theory. Author

**N71-33614#** Oak Ridge National Lab., Tenn.
**NEW ISOMER OF Rh 110 (T 1/2 = 28 s)**
J. A. Pinston and F. Schussler 1970 11 p refs Transl. into ENGLISH from Nucl. Phys. A (Amsterdam), no. 144, 1970 p 42−52 Sponsored by AEC
(ORNL-tr-2405) Avail: NTIS

Study of beta and gamma activities produced by (n,p) reaction of enriched Pd-110 has shown a new Rh-110 isomer, of 28 sec half-life. Six new levels at 1398, 1574, 1900, 2448, 2791, and 2804 keV are attributed to Pd-110. The decay energy of this new isomer is estimated at 5400 keV. Also measured with good accuracy was the half-life of the other isomer of Rh-110. Author (NSA)

**N71-33618#** Oak Ridge National Lab., Tenn.
**INCLUSION OF FISSION AND CHARGED PARTICLE EMISSION IN CALCULATIONS OF NUCLEAR REACTIONS; COMPUTED ENERGIES, ANGLES, AND RANGES OF RECOIL NUCLEI**
R. L. Hahn and O. W. Hermann 7 Apr. 1971 53 p refs
(Contract W-7405-eng-26)
(ORNL-TM-3179) Avail: NTIS

Modifications of the code I4C(EVAP) are discussed that include effects due to competition between particle emission and fission and detailed calculations of the kinetic energies, angles, and recoil ranges of product nuclei. It is demonstrated that the cross section for the evaporation from compound-nucleus c of any particle k, be it neutron or charged particle, can be expressed as sigma(c,k,f) = sigma sub c P sub k [Gamma sub n/(Gamma sub n + Gamma sub f)]k, where gamma sub c is the compound-nucleus-formation cross section, P sub k is the usual probability of emission of k in the absence of fission, and the factor in brackets considers the competition between fission and particle emission. This result is to be contrasted with earlier treatments that took P sub k = 0 unless particle k was a neutron. The empirical formula of Sikkeland, Ghiorso, and Nurmia with its simple dependence upon atomic number Z and neutron number N, is shown to be an appropriate measure of [Gamma sub n/(Gamma sub n + Gamma sub f)] in cases where charge particles as well as neutrons compete with the fission process. To obtain kinetic-energy and angular distributions of product nuclei, the transformation of the velocity of the nucleus from center-of-mass to laboratory system is treated in detail. Author (NSA)

**N71-33669#** Minnesota Univ., Minneapolis. Tate Lab. of Physics.
**AN NMR AND NUCLEAR RELAXATION STUDY OF SATELLITE LINES IN DILUTE Co-Cr, Co-V, AND Co-Nm ALLOYS**
J. Aslam and W. Weyhmann Mar. 1971 77 p refs
(Contract AT(11-1)-1569)
(COO-1569-71) Avail: NTIS

The distribution of hyperfine fields at cobalt nuclei in the dilute alloys of Co-Cr, Co-V, and Co-Mn was investigated using NMR techniques at 4.2 K. The spectra for Co-Cr and Co-V alloys were characterised by three satellite lines in addition to the main cobalt line. In each of these two cases, the nearest neighbor line was split into two components due to dipolar and pseudodipolar effects in the domain wall. The splitting gave a pseudodipolar moment of −(6.1 + or − 0.7)mu sub B for a Cr impurity in cobalt and −(4.3 + or − 0.7)mu sub B for a V impurity in cobalt. The third satellite line in these systems was shown to arise from cobalt atoms in the third neighbor shell around the impurity. A phenomenological model similar to that of Streever and Uriano and Kobayeshi et al. has been used to predict the hyperfine field shifts corresponding to the Zeeman frequency of the various neighboring satellite lines. Author

**N71-33686*#** Pittsburgh Univ., Pa. Dept. of Physics.
**GLAUBER THEORY OF ATOMIC HYDROGEN EXCITATION BY ELECTRON IMPACT**
H. Tai, R. H. Bassel, E. Gerjuoy, and V. Franco (Brooklyn Coll.) [1971] 50 p refs Sponsored in part by AEC
(Grant NGR-39-011-035; Contract DA-31-124-ARO(D)-440)
(NASA-CR-121444) Avail: NTIS CSCL 20H

The Glauber approximation was applied to excitation of the 2p, 3s and 3p levels of the hydrogen atom by electron impact. The differential and integrated excitation cross sections predicted by Glauber theory were compared with experimental results and with other calculations. The Glauber approximation is a considerable improvement over the Born approximation at energies < approximately 100 eV. At energies > approximately 100 eV the Glauber total excitation cross section approach the Born, even though at large scattering angles (> 40 deg) the Glauber differential cross sections may be very different from the Born. At intermediate energies (approximately 30 eV to 100 eV) the Glauber predictions are surprisingly good; at energies < approximately 20 eV the Glauber integrated cross sections are rather smaller than those observed experimentally. Author

**N71-33694** Rutgers Univ., New Brunswick, N.J.
**ISOBARIC ANALOG STUDIES IN THE OSMIUM AND PLATINUM MASS REGION**

Marilyn Wiesen (Ph.D. Thesis) 1970 209 p
Avail: Univ. Microfilms Order No. 70-16959

Isobaric analog states of Os-189,191,193 and Pt-195,197,199 were studied as compound-nucleus resonances in Ir-189,191,193 and Au-195,197,199 by proton scattering from isotopically enriched Os-188,190,192 and Pt-194,196,198 targets. Studies of Os-188,190,192 (d,p) reactions were also performed: the energies of the levels populated in the parent nuclei, Os-189,191,193, by the deuteron stripping reactions were identified up to approximately 2.0 MeV excitation energy. Parameters for the resonances observed in elastic proton scattering were extracted using a modified R-matrix theory which treated overlapping resonances; linear energy-dependent optical-model phase shifts were included in order to describe the nonresonant background. Spectroscopic factors for the analogs of the 9/2+ states in the odd-mass Pt isotopes were calculated. The sensitivity of the computations to the various input parameters was also investigated. Dissert. Abstr.

**N71-33695** Colorado Univ., Boulder.
**MEASUREMENTS OF FIRST EXCITED STATE LIFETIMES OF THE GROUP 3 ELEMENTS: GALLIUM, INDIUM AND THALLIUM**
Michael Kent Norton (Ph.D. Thesis) 1969 124 p
Avail: Univ. Microfilms Order No. 70-16510

The lifetimes of the gallium 5 2S1/2 state, indium 6 2S1/2 state, and the thallium 7 2S1/2 state were measured using zero-field level-crossing (Hanle effect) techniques. The lifetimes obtained were: 6.8 + or − .3 × 10 to the minus 9th power sec, 7.0 + or − .4 × 10 to the minus 9th power sec, and 7.45 + or − .2 × 10 to the minus 9th power sec, respectively. These experiments were performed by exciting the atoms of an atomic beam from the 2P1/2 (ground) state to the 2S1/2 state using circularly polarized resonance radiation and detecting circularly polarized light from the 2S1/2 yields 2P3/2 decay. Magnetic field modulation and phase sensitive detection were used. Data was taken at several different modulation fields and atomic beam densities in order to evaluate and correct for sources of error resulting from modulation broadening and multiple scattering narrowing. Corrections were made to remove sources of error arising from frequency dependence of the exciting light intensity and self-absorption by the atomic beam. Dissert. Abstr.

**N71-33703#** California Univ., Berkeley. Lawrence Radiation Lab. Dept. of Chemistry.
**HYDROGEN-NITRIC OXIDE SPIN EXCHANGE CROSS SECTION**
Philip Dow (Ph.D. Thesis) Mar. 1971 95 p refs
(Contract W-7405-eng-48)
(UCRL-20529) Avail: NTIS

The construction of a spectrometer to detect the transition (1.420 GHz) between the hyperfine levels of the hydrogen atom Zeeman-perturbed at zero magnetic field is described. This splitting of the 2S1/2 ground state arises from the spin-spin coupling of the proton and the electron. In considering several detection methods, the balanced transmission scheme, in which the sample of hydrogen gas forms one arm of an equivalent null bridge circuit, is found to be far superior to the reflection scheme commonly used in ESR work. Also, the modulation scheme employs a rotating quasi-static magnetic field, instead of the small additional sinusoidal field, in contrast to most ESR spectrometers. The spectrometer is used to investigate the spin-exchange reaction between hydrogen atoms and nitric oxide in a flow system at pressures of about 1 torr. Under these experimental conditions, the residence time of the hydrogen atoms in the radiation field is quite long. Author (NSA)

**N71-33704#** Los Alamos Scientific Lab., N.Mex.
**CALIBRATION OF MOXON-RAE DETECTORS IN THE CURRENT MODE**
A. N. Ellis, W. K. Brown, J. A. Farrell, and R. R. Fullwood Jun. 1970 15 p refs
(Contract W-7405-eng-36)
(LA-4445) Avail: NTIS

Moxon-Rae type gamma-ray detectors were used for neutron capture cross-section measurements employing neutrons from an underground nuclear explosion. The efficiency of these detectors was measured. Two detectors were used to view thin strips of gold and U-238 mounted on the inside of a spinning drum. The collimated neutron beam was passed through the drum. The drum speed was suffcient to resolve the individual low-energy gold and uranium resonances that appeared as spots of activation on the strips. The spots were located by autoradiographs, cut out, and beta counted. The detector efficiency was determined by comparing the absolute activation in each resonance with the integrated signal recorded from the detectors. The measurement is independent of any knowledge of the neutron flux or of the capture cross sections involved. Author (NSA)

**N71-33706#** Michigan State Univ., East Lansing. Dept. of Physics and Astronomy.
**SOME OBSERVATIONS CONCERNING THE USE OF REALISTIC FORCES IN A MICROSCOPIC DESCRIPTION OF THE INELASTIC SCATTERING OF NUCLEONS FROM NUCLEI AT MEDIUM ENERGIES**
Fred L. Petrovich (Ph.D. Thesis) 1970 282 p refs Sponsored by AEC
(COO-1051-34) Avail: NTIS

Several models for nucleon-nucleus scattering are investigated by direct calculation. All of the interaction models considered are consistent with some portion of the data concerning the free two nucleon force; hence, the term realistic forces. It is assumed that the projectile-target interaction is given by (1) a pseudo-potential derived from the impulse approximation, (2) the long range part of the Kallio–Koltveit potential which is known to be a good approximation to the central part of the shell model reaction matrix, and (3) a Yukawa force derived from effective range theory. The local distorted wave approximation is used throughout, and no consideration is given to components of the interaction with complicated spin dependence such as the tensor. Approximations are made to treat the exchange component of the transition amplitude which is nonlocal. Application is made to (p,p') transitions in closed and pseudo-closed shell nuclei. Author (NSA)

**N71-33707#** California Univ., Berkeley. Lawrence Radiation Lab.
**BERKELEY ERA PROGRAM**
Edward J. Lofgren Feb. 1971 4 p refs Presented at Natl. Part. Accel. Conf., Chicago, 1 Mar. 1971
(Contract W-7405-eng-48)
(UCRL-20611; Conf-710308-18) Avail: NTIS

The scope and status of the Berkeley Electron Ring Accelerator (ERA) program are reviewed. Author (NSA)

**N71-33711*#** College of William and Mary, Williamsburg, Va.
**THE 2s ATOMIC LEVEL IN NUONIC 208-Pb**
D. A. Jenkins (Virginia Polytech. Inst.), R. J. Powers (Virginia Polytech. Inst.), P. Martin, G. H. Miller, and R. E. Walsh [1971] 63 p refs Sponsored in part by NSF Prepared in cooperation with Virginia Polytech. Inst.
(Grant NGL-47-004-006)
(NASA-CR-121447) Avail: NTIS CSCL 20H

The measurement of the energies and the relative intensities of various muonic atomic transitions above 500 keV in Pb-208 including transitions to and from the 2s level, is reported. Besides the usual E1 transitions the 3d yields 1s and 4d yields 2p E2 transitions were observed. Interpretation of these data in terms of various charge distributions is made. Appreciably better fits are

obtained by assuming the presence of nuclear polarization and allowing the nuclear polarization parameters Delta E(1s) and Delta E(2s) of the 1s and 2s levels to vary. Least squares fits indicate values of Delta E(1s) = −8.9 + or − 2.7 keV and Delta E(2s) = −0.6 + or − 0.7 keV. Comparisons with electron scattering results are made. Author

**N71-33731** New York Univ., N.Y.
**HYPERFINE STRUCTURE AND ISOTOPE SHIFT OF 30-YEAR Bi 207 IN THE 3067-A RESONANCE LINE**
Robert Chuckrow (Ph.D. Thesis) 1969 104 p
Avail: Univ. Microfilms Order No. 70-16045

A 10 m focal length Czerny−Turner monochromator was used to record the emission spectrum of 30-yr Bi-207 to obtain the hyperfine structure (hfs) and isotope shift (IS) of Bi-207, with respect to the naturally occurring isotope Bi-209, in the 3067 A transition. A procedure was developed for making an impurity-free electrodeless spectral lamp utilizing only nanogram quantities of Bi-207. The radioisotope was produced in a cyclotron bombardment of lead, and then mass separated. The Bi-209 6p2(3P0)7S 4P1/2 level hfs separation which was used as a calibration and the Bi-209 6p3 2D3/2 hfs were also measured with the aid of a Fabry−Perot interferometer. Attempts to obtain Bi-208 hfs and IS data were foiled by excessive Bi-209 impurity. The calculations for the Bi-207 magnetic-dipole and electric-quadrupole interaction constants and the IS are based on the theoretically-expected value I = 9/2. Dissert. Abstr.

**N71-33733#** Idaho Nuclear Corp., Idaho Falls.
**NEUTRON FILTERED BEAMS AS STANDARD SOURCES**
O. D. Simpson, J. R. Smith, and J. W. Rogers 1971 7 p refs Presented at the 3d Conf. on Neutron Cross Sect. and Technol., Knoxville, Tenn., 15 Mar. 1971 Sponsored by AEC
(Conf-710301-8) Avail: NTIS

High-intensity sources of 2-, 24.5-, and 144-keV neutrons were produced using filtered-beam techniques. The beams of neutrons were produced by placing thick filters of scandium, iron, and silicon into beam holes of a reactor. Development work has consisted of determining optimum lengths, finding techniques to deal with backgrounds, and making some pilot total neutron-cross-section measurements. These filtered beams constitute a distinctive set of neutron sources and offer constant, well-collimated neutron beams of high intensity for their energy region. They could be established as standard sources of neutrons for the fast-breeder program. While the energy resolution is wider than that of some facilities, there is no instrument capable of resolving all the detailed structure encountered in the keV region. The filtered beams represent an intermediate case between differential and integral measurements, and will be of additional help in resolving discrepancies between these types of measurements. Author (NSA)

**N71-33735*#** Pittsburgh Univ., Pa. Space Research Coordination Center.
**DISSOCIATIVE EXCITATION OF VACUUM ULTRAVIOLET EMISSION FEATURES BY ELECTRON IMPACT ON MOLECULAR GASES. 1: H2 AND O2**
M. J. Mumma and E. C. Zipf May 1971 39 p refs Submitted for publication
(Grants NGL-39-011-030; NGL-39-011-002; Contract DA-31-124-ARO(D)-440)
(NASA-CR-121417; SRCC-152) Avail: NTIS CSCL 20H

The HI 1215.67 A Lyman alpha line and the OI 1302.17, 1304.87, 1306.04 A multiplet have been excited by electrons impacting on H2 and O2, respectively. Their excitation cross sections have been measured over the energy range from threshold to 350 eV. The cross section for dissociative excitation of Lyman alpha has a peak value of 1.23 × 10 to the minus 17th power sq cm + or − 11% while the cross section for the OI 1300 A multiplet has a maximum value of 3.8 × 10 to the minus 18th power sq cm + or − 17%. The cross section for dissociative excitation of the OI 1217.6 A line is 1.5 × 10 to the minus 19th power sq cm 24% at 100 eV. Author

**N71-33736#** Roswell Park Memorial Inst., Buffalo, N.Y.
**[RESEARCH ON RADIATION DAMAGE PROCESSES AT THE MOLECULAR LEVEL] Annual Progress Report, Feb. 1971**
Feb. 1971 3 p refs
(Contract AT(30-1)-3558)
(NYO-3558-24) Avail: NTIS

Research on radiation damage processes at the molecular level is reviewed. NSA

**N71-33737#** Atomic Energy Commission, Washington, D.C. Div. of Research.
**CONFERENCE ON HEAVY ION SOURCES**
1970 260 p refs Conf. held at Washington, D.C., 13 Mar. 1970
(WASH-1159; Conf-700337) Avail: NTIS

The conference on heavy ion sources is reported. Topics discussed include: monoenergetic bromine and iodine ions, heavy ion beams produced by single-impact ionization, injection of electron beam into cusped magnetic field, production of highly charged ions, electron ring injection and containment, highly stripped heavy ions, ion production with intense electron beams, and production of transuranic elements. F.O.S.

**N71-33744** Connecticut Univ., Storrs.
**A COINCIDENCE STUDY OF NITROGEN ION-ARGON ATOM COLLISIONS AT KILOVOLT ENERGIES**
Emile John Knystautas (Ph.D. Thesis) 1970 55 p
Avail: Univ. Microfilms Order No. 70-15642

Single collisions are studied between nitrogen ions scattering from argon atoms at laboratory energies 10 keV < or = to T sub 0 < or = to 150 keV and laboratory scattering angles 9 deg < or = to theta < or = to 40 deg. A collision is specified by fixing T sub 0 and theta. In an (m,n) reaction, the nitrogen ion scatters into angle theta with charge +m, and the argon target recoils into angle phi = beta - theta with charge +n. After collision, both ions are detected in coincidence and are charge-state analyzed. A coincidence profile plots relative coincidence counts versus beta and is generally Gaussian-shaped. Two types of data result. The area under a coincidence profile for an (m,n) reaction is proportional to the relative probability of that reaction. For classically calculated distances of closest approach the coincidence profiles indicate unresolved structure. The fraction of inelastic energy received by each ion is estimated on the basis of several models, and their results are compared. Dissert. Abstr.

**N71-33767#** Cambridge Electron Accelerator, Mass.
**HIGH ENERGY PHYSICS EXPERIMENTS, ACCELERATOR OPERATION, AND COLLIDING BEAM FACILITY Semiannual Report for the Period 1 Jan. −30 Jun. 1970**
30 Nov. 1970 56 p refs
(Contract AT(30-1)-2076)
(CEAL-1053) Avail: NTIS

Data on accelerator operation for experimenters shows that the total number of delivered prime-user hours and parasite-user hours in the first half of 1970 was 4502. The 18 experiments that were underway are described. Progress on the development of the colliding beam facility in which electron and positron beams, each with an energy of 3.5 GeV, will collide with an available energy of 7.0 GeV in the center-of-mass system is summarized. Stored electron and positron beams were accumulated with peak currents of 25 and 11 mA respectively. Changeover from cycling mode storage to dc storage was accomplished with an efficiency exceeding

90% at peak beam currents of 3 mA or less. Unacceptable losses still occurred at large beam intensities. A dc-stored beam 1/e lifetime of two hours was achieved. Electron beams were switched into the bypass successfully, with a 1/e lifetime of 45 minutes. Author (NSA)

**N71-33782#** General Electric Co., Pleasanton, Calif. Nucleonics Lab.

**FISSION GAS RE-SOLUTION RATES: LIMITATION OF FISSION GAS BUBBLE GROWTH BY THE RE-SOLUTION PROCESS**

M. O. Marlowe Nov. 1970 22 p refs
(Contract AT(04-3)-189)
(GEAP-12148) Avail: NTIS

The experimental evidence and theoretical analyses of the process of re-solution of fission gas from bubble nuclei in irradiation environments are reviewed. Gas bubble nucleation kinetics are reviewed and it is shown that the model for gas-generation rate-controlled nucleation process is consistent with experimental evidence and the range of uncertainty in the reinjection probability per unit time. The growth of static fission gas bubbles from the nucleation stage in the presence of the re-solution process is considered. It is shown that the parameter (DF/sq b) where D is the gas diffusivity in the fuel, F is the fission rate, and b is the reinjection probability per unit time, must exceed approximately 10 to the 9th power/cm if bubble growth is to occur. It is shown that the uncertainties in the reinjection probability give uncertainties in the temperature at which bubble growth can occur of the order of 600 to 800 C depending on fission rate. Author (NSA)

**N71-33785#** Iowa State Univ. of Science and Technology, Ames. Ames Lab.

**MODEL ANALYSES OF ELEMENTARY PARTICLE SCATTERING AMPLITUDES**

Thomas Patrick Coleman (Ph.D. Thesis) Feb. 1971 83 p refs
(Contract W-7405-eng-82)
(IS-T-426) Avail: NTIS

Several models of high energy scattering reactions are examined. First, the s wave S matrix of the double delta-function potential barrier does not contain a second-order pole, in contrast to an earlier analysis of the same potential. This suggests that the crossing of resonance levels with the same symmetry does not occur. Second, a model in which the Az(1300) meson consists of two coupled mesons of the same spin and parity is used to explain the variations of the mass structure of the A2 in several experiments. The roles of these two mesons in group classifications of elementary particles and in S matrix theory are discussed. Third, the double Regge pole models of Berger, of Chan, Kajantie, and Ranft, and of Chan, Loskiewicz, and Allison are compared with data from the reaction pp yields p pion(−) Delta(2+) at 22 GeV/c. Berger's model is most consistent with the data and with earlier analyses. The relative merits of the three models are discussed. Author (NSA)

**N71-33793#** California Univ., Berkeley. Lawrence Radiation Lab.

**BETA DELAYED PROTONS FROM Al 23**

R. A. Gough, Joseph Cerny, R. G. Sextro, and John E. Esterl Feb. 1971 7 p refs Presented at Intern. Conf. on Heavy Ion Phys., Dubna, USSR, 11 Feb. 1971
(Contract W-7405-eng-48)
(UCRL-20436; Conf-710209-1) Avail: NTIS

The Mg-24(p,2n)Al-23 reaction was used to produce the lightest nucleon-stable member of the A = 4n + 3, Tz = −3/2 mass series. By using standard particle-identifier techniques, a delayed proton group at 0.88 + or − 0.04 MeV (cm) following the decay of Al-23 was observed with a half-life of 0.48 + or − 0.06 sec. An energy spectrum of identified protons and excitation functions are shown. NSA

**N71-33795#** Los Alamos Scientific Lab., N.Mex. Minnesota Univ., Minneapolis.

**EFFECT OF THE MULTIPOLE PAIRING AND PARTICLE HOLE FIELDS IN THE PARTICLE VIBRATION COUPLING OF Pb 209. I**

D. R. Bes and R. A. Broglia [1970] 67 p refs Prepared in cooperation with Minn. Univ., Minneapolis
(Contracts W-7405-eng-36; AT(11-1)-1764)
(LA-DC-11648; COO-1764-108) Avail: NTIS

The particle−vibration coupling formalism for nuclei around closed shells is studied, and a microscopic description is given. Both particle−hole excitations and excitations that change the number of particles by two (pairing mode) are considered as collective modes of excitation of the closed-shell-system ground state. To describe the pairing modes, multipole pairing residual interactions are used. The odd particle is allowed to couple to both types of vibrations. The coupling Hamiltonian is linear in the collective phonons and the particle variables. The effective Hamiltonian is constructed by a perturbative method. Explicit expressions are given for the spectroscopic amplitudes and spectroscopic factors associated with these reactions. Author (NSA)

**N71-33798#** WADCO Corp., Richland, Wash. Hanford Engineering Development Lab.

**CROSS SECTION STRUCTURE FACTOR INTERPOLATION SCHEMES**

R. B. Kidman Mar. 1971 16 p refs
(Contract AT(45-1)-2170)
(HEDL-TME-71-40) Avail: NTIS

To carry out multigroup calculations requires effective group cross sections. One way of obtaining such cross section sets is to multiply infinitely dilute group constants with temperature and composition dependent correction factors. Since only a finite number of reactor compositions can be represented in any table of f-factors, interpolation schemes are used to obtain f-factors for media with intermediate temperatures and/or compositions. The actual structure factor behavior has suggested new interpolation schemes. These new schemes (1DX-M1) are described and some comparisons made with previous interpolation routines. Author (NSA)

**N71-33806#** Rensselaer Polytechnic Inst., Troy, N.Y.

**LINEAR ACCELERATOR PROJECT Annual Technical Report, 1 Oct. 1969−30 Sep. 1970**

30 Sep. 1970 235 p refs
(Contract AT(30-1)-328)
(RPI-328-200) Avail: NTIS

Neutron capture and total cross section measurements were carried out to several hundred keV on V, Cr-50, Cr-52, Cr-53, Cr-54, and Ni-60. From these measurements, resonance parameters, average capture cross sections, s wave and p wave strength functions, potential scattering radii, and average level spacings were determined. Also, an interesting correlation was observed between the reduced neutron width and total radiation width of the s wave resonances in even nuclei. High resolution total cross section measurements on sodium, carbon, and hydrogen were carried out up to 40 MeV with a proton recoil detector. Neutron spectrum measurements in large assemblies of iron and depleted uranium provided a basis of comparison of cross section sets; principally ENDF/B and Karlsruhe. Significant discrepancies were observed with respect to the cross sections sets, and also the DTF-4 transport code. A large vessel for containment of metallic sodium was fabricated. Author

**N71-33812#** Akademiya Nauk URSR, Kiev. Inst. Teoreticheskoi Fiziki.

**SOME INELASTIC MESON-BARYON REACTIONS IN GENERALIZED VENEZIANO MODEL**

L. L. Enkovski, V. V. Kukhtin, and V. V. Timokhin 1970 22 p refs

(ITF-70-77) Avail: AEC Depository Libraries

Inelastic meson baryon scattering processes are investigated in the framework of the 5-point Veneziano amplitude. These reactions are pion(−) proton yields proton kaon(0) kaon(−), pion(−) proton yields Lambda hyperon kaon(+) pion(−), pion(−) proton yields neutron kaon(0) antikaon(0), pion(−) proton yields Sigma(0) hyperon kaon(0) pion(0), pion(−) proton yields Lambda hyperon kaon(0) pion(0), pion(−) proton yields Sigma(0) hyperon kaon(+) pion(−). Cross sections and effective mass distributions are calculated. Author (NSA)

**N71-33814** New York Univ., N.Y.

**ELECTRON-POTASSIUM INELASTIC DIFFERENTIAL CROSS SECTION MEASUREMENTS WITH SPIN ANALYSIS**

Marvin Goldstein (Ph.D. Thesis) 1969 125 p

Avail: Univ. Microfilms Order No. 70-16065

Measurements were made of the fractional depolarization of a polarized atom beam by electron impact for the 2S1/2 to 2P1/2,3/2 transition in potassium. These measurements were related to the various direct and exchange scattering amplitudes which are necessary to describe differential inelastic electron-potassium collisions. Measurements were made in the energy range 1.6 to 20eV for a nominal electron scattering angle of 0 deg, and in the energy range 3 to 10eV for nominal electron scattering angles in the range 0 to 20 deg. The crossed beam atomic recoil technique was used. A polarized and velocity selected atom beam was cross-fired at 90 deg by an unpolarized electron beam. The scattered atoms were spin analyzed with an E-H gradient magnet. Dissert. Abstr.

**N71-33815#** California Univ., Berkeley. Dept. of Physics.

**MASS SPECTROSCOPY RESEARCH Progress Report**

19 Oct. 1970 17 p refs Sponsored by AEC

(UCB-34-P-32-PR-5) Avail: NTIS

Findings in the spectroscopic analysis of 11 samples of Apollo 11 material were reported. The results of studies on Apollo 12 rock 13, unique lunar rock of small size, very much enriched in the radioactive elements uranium, rubidium, and potassium were presented. Completed research on a few meteorites that did not give an I-Xe age was given. Research and Development in mass spectroscopic techniques was included. J.G.M.

**N71-33816** Yeshiva Univ., New York.

**ON PARTICLE MULTIPLE AND DIFFRACTION SCATTERING AND DIPS**

Ronald Sherman Dorfman (Ph.D. Thesis) 1970 127 p

Avail: Univ. Microfilms Order No. 70-17105

A model for high energy pion nucleon charge exchange scattering was presented. The asymptotic generalized optical eikonal model of Chou and Yang (for elastic scattering) was employed. Energy dependence was introduced by combining this model with Regge theory. The Regge term could correspond to a single scattering term, and the whole amplitude to generalized multiple scattering. The following results were obtained for this model: It was proved analytically that there existed no maxima, zeros, or interference dips in plots of differential cross section vs. momentum transfer squared for various energies when the residue function was one (all spin factors, etc., were absorbed). A dip was created by placing a zero in the residue function for various energies. The dip was seen to occur at a smaller value of momentum transfer squared than the original zero by employing semi-log plots. Semi-log plots were also employed to demonstrate that the created dips did not move with energy along the horizontal axis for various energies considered. Dissert. Abstr.

**N71-33820#** Royal Inst. of Tech., Stockholm (Sweden). Dept. of Polymer Technology.

**ELECTRON SPIN RESONANCE STUDIES OF FREE RADICALS FORMED IN ELASTOMERS BY ULTRAVIOLET IRRADIATION**

Peter Carstensen 1970 26 p refs

(APC-CH-97) Avail: NTIS; Sw. Kr. 10.00

The radicals formed by ultraviolet light from a medium pressure mercury lamp at liquid nitrogen temperatures in poly(isobutene), cis-1,4-poly(isoprene), cis-1,4-poly(butadiene), and cis-1,4-poly(piperylene) are summarized and discussed in relation to bond energies, to end products formed by both high energy and uv irradiation, and to the results from other polymers. Author

**N71-33832** Cornell Univ., Ithaca, N.Y.

**A STUDY OF UMKLAPP SCATTERING AND TRANSPORT COEFFICIENTS IN SIMPLE METALS**

Walter Edward Lawrence, III (Ph.D. Thesis) 1970 121 p

Avail: Univ. Microfilms Order No. 70-17089

Two-plane-wave models for electron-electron and electron-phonon umklapp scattering, and their effect upon the transport properties of simple metals, are discussed. For the electron-electron scattering problem a variational approach to the Boltzmann equation is used. According to the model the electron-electron scattering contribution to resistivity is as large in alkali metals as in the simple polyvalent metals studied, in apparent contradiction with tentative conclusions drawn from experiment. If further experiments confirm these conclusions, electron-phonon umklapp scattering is suggested as a possible explanation. It is shown that its contribution to resistivity does not die exponentially at low temperatures in polyvalent metals, as it does in alkali metals. Dissert. Abstr.

**N71-33833#** California Univ., Berkeley. Lawrence Radiation Lab.

**NEGATIVE MASS INSTABILITIES IN AN ELECTRON RING COMPRESSOR**

A. C. Entis, A. A. Garren, and L. Smith Feb. 1971 5 p refs Presented at Natl. Part. Accelerator Conf., Chicago, 1 Mar. 1971

(Contract W-7405-eng-48)

(UCRL-20208; Conf-710308-7) Avail: NTIS

Experiments on Compressor show strong evidence of a negative mass instability which develops immediately after injection and generates such a large energy spread that the achievement of electron densities in the range of interest for trapping and accelerating ions becomes very difficult. Two models for the compressor are explored: a straight ceramic tube coated with a thin metallic layer and a metallic pillbox with lossy walls. The first model accounts for the significant materials seen by the beam, and the second model provides a more realistic representation of the compressor geometry. Results of the study have proven to be a useful indication of the problem by predicting the very rapid growth rates observed above threshold and suggesting that thresholds can be raised substantially by the use of suitable metallic coatings. NSA

**N71-33844#** Eidgenossische Technische Hochschule, Zurich (Switzerland).

**THE ENERGY DEPENDENCE IN PROXIMITY SCATTERING [LA DEPENDANCE EN ENERGIE DE LA DIFFUSION DE PROXIMITE]**

Gerard Thievent (Ph.D. Thesis) 1970 49 p refs In FRENCH; ENGLISH summary

(THESIS-4469) Avail: NTIS

A nuclear reaction with three outgoing particles can proceed in two sequential stages if one of the product particles of the first step is unstable. Under certain conditions two of the three particles in the final state can undergo a further reaction (proximity scattering). In order to show the contribution of this process unambiguously, it is necessary to observe it at different energies of the incident particles. The (alpha,n) proximity scattering of the neutron and of one of the alpha-particles emitted in the decay of

Be-8 in the reaction Li-7(d,n alpha)He-4 has been studied at different energies of the incident deuterons between 2.07 and 2.27 MeV. A quantal calculation of the reaction cross section is presented, assuming that the contribution of few simple graphs is important. Author

**N71-33858#** Argonne National Lab., Ill.
**ARC SYSTEM: ONE-DIMENSIONAL TRANSPORT THEORY CAPABILITY SNARC1D**
L. T. Bryant and G. K. Leaf Jan. 1971 387 p refs
(Contract W-31-109-eng-38)
(ANL-7717) Avail: NTIS HC$6.00/MF$0.95

The modules described are based upon a translation of the transport code SNARG-1D. The computational module NUC003 solves the discrete-ordinate S sub N approximation to the one-dimensional multigroup neutron transport equation. Module NUI005 processes the input data required for execution of NUC003. Module-dependent input is accepted in the form of a BCD data set and/or a binary data set. Isotropic and linearly anisotropic scattering between energy groups is permitted. Real or adjoint solutions may be calculated for homogeneous or inhomogeneous problems. Standard angular quadrature sets for S sub N orders up to 16 are provided for slab and spherical geometry. Alternative angular quadrature schemes may be obtained by supplying appropriate input. Inhomogeneous sources of two types are permitted: volume sources (neutrons per unit volume per sec) and surface sources (neutrons per unit surface area per sec). Author (NSA)

**N71-33867#** Australian National Univ., Canberra. Dept. of Nuclear Physics.
**A SEARCH FOR HIGH-SPIN STATES IN Al 27**
K. W. Carter, D. C. Kean, C. J. Piluso, and R. H. Spear 1971 24 p refs
(ANU-P/521) Avail: NTIS

A search has been made for high-spin states in Al-27 in the range of excitation energies E sub x from 4.8 to 8.0 MeV using the reactions C-12(O-16,p)Al-27 and Mg-24(alpha,p)Al-27). Gamma-ray branching ratios and proton-gamma angular correlations have been measured for prospective high-spin states. Although no unambiguous spin and parity assignments were obtained, it is argued that states at E sub x = 5499, 6716, 6952, 7226, and 7441 keV probably have spins and parities 11/2(+), 9/2(+), 11/2(+), 9/2(+ or −) or 11/2(+), and 13/2(+), respectively. An attempt is made to interpret the results in terms of the strong-coupling rotational model. Author

**N71-33877#** Nice Univ. (France). Lab. de Physique Theorique.
**EXCHANGE DEGENERACY AND ABSORPTION IN ANTIPROTON PROTON YIELDS ANTIHYPERON HYPERON**
Guy Plaut Jun. 1971 23 p refs
(N-TH-71/2) Avail: NTIS

The anti-Lambda hyperon Lambda hyperon, anti-Lambda hyperon Sigma(0) hyperon or anti-Sigma(0) hyperon Lambda hyperon, and anti-Sigma(0) hyperon Sigma(0) hyperon productions in antiproton proton scattering are studied with the help of absorbed K*-K** Regge pole model with exchange degeneracy. It is shown that the model fits the cross sections and the polarization data in antiproton proton yields anti-Lambda hyperon Lambda hyperon rather well. A reliable measurement of polarization correlation coefficients should provide a crucial test of the model. Author

**N71-33878#** Rochester Univ., N.Y. Nuclear Structural Research Lab.
**[NUCLEAR STRUCTURE RESEARCH AND INSTRUMENTATION DEVELOPMENT] Annual Report, 1970**
1970 165 p refs
Avail: NTIS

The 1970 Annual Report of the Nuclear Structure Research Laboratory activities is presented. Covered are: (1) scientific research and development programs under investigation; (2) data acquisition system; (3) proportional and spark counter development; (4) electronics; (5) health physics services; (6) pulsed beam system and accelerator performance; (7) program for summer science assistants; (8) laboratory personnel; and (9) reports, publications, and papers presented at meetings. A.L

**N71-33879#** International Atomic Energy Agency, Vienna (Austria).
**NUCLEAR ENERGY AND THE ENVIRONMENT Addendum to the Agency's Report to the Economic and Social Council of the United Nations for 1969–1970**
[1970] 20 p refs
(INFCIRC/139/Add-1) Avail: NTIS

The application of nuclear energy to meet the power demands of an increasing population is discussed. The reduction in air pollution and improvement in environmental conditions is considered. The technology for containment and disposal of radioactive wastes is reported. Author

**N71-33881#** Kyoto Univ. (Japan). Research Inst. for Fundamental Physics.
**DOES DUALITY HOLD IN CURRENT INTERACTIONS?**
Zyun F. Ezawa (Tokyo Univ.) May 1971 8 p refs
(RIPF-125) Avail: NTIS

With the analysis of the inelastic electron-proton scattering, it is shown that current amplitudes do not obey duality. It is also pointed out that a scaling variable omega prime = omega + a/q sq absolute is too artificial to extract information from experimental data. Author

**N71-33888#** Oak Ridge National Lab., Tenn.
**REPORT TO THE AEC NUCLEAR CROSS SECTION ADVISORY COMMITTEE**
W. M. Good Apr. 1971 26 p refs
(Contract W-7405-eng-26)
(ORNL-TM-3378) Avail: NTIS

This memo is a collection of brief reports on recent and not yet generally publicized work at ORNL that is of special interest to the NCSAC. Included are abstracts of relevant ORNL reports, as well as papers that have been only submitted for publication. The memo covers the period of time since the last NCSAC meeting. Author (NSA)

**N71-33901** New York Univ., N.Y.
**FEYNMAN PATH INTEGRALS AND SCATTERING THEORY**
Donald Gelman (Ph.D. Thesis) 1969 109 p
Avail: Univ. Microfilms Order No. 70-16063

The Feynman path integral formulation of nonrelativistic quantum mechanics is applied to the scattering theory. A particularly appealing result of Feynman's is a variational upper bound (VUB) on the ground state energy, with the bound expressed in terms of path integrals containing a trial function. When the trial function is of the standard form, with the kinetic energy and a trial potential, the bound reduces to the Rayleigh-Ritz result. Since the trial function need not be of this form, Feynman's result has interesting new possibilities. For central potentials, Feynman's analysis is extended to the subspace of states of a given angular momentum, obtaining a VUB on the energy of the lowest energy bound state within the subspace. By exploiting the analogy between the lowest energy bound state and the zero energy scattering state in the no bound state case, a VUB on A sub L

the parameter which characterizes low energy scattering in the subspace is obtained. The bound on A sub L is expressed in terms of modified path integers containing a trial function, and it reduces to the usual result if and only if the trial function is of the standard form. Dissert. Abstr.

N71-33905 Oregon Univ., Portland.
**THE BUBBLE MODEL FOR AN EXCESS ELECTRON IN LIQUID HELIUM**
Peter Eugene Parks (Ph.D. Thesis) 1969 108 p
Avail: Univ. Microfilms Order No. 70-15350

The microscopic foundation of the phenomenological bubble model for an excess electron in liquid helium is discussed. It is shown that the simple intuitive ideas can easily be formulated mathematically in terms of a variational ansatz at absolute zero. A reformulation of the problem at finite temperature in a manner paralleling the absolute zero approach, however, yields nonsense. The difficulty is shown to result from attempting to characterize the bubble in terms of inhomogeneous one particle distribution functions and that such a description is a consequence of the approximation and is incompatible with all exact solutions. A definition of a bubble is then given in terms of the impurity singlet density matrix. It is shown that the physical picture of an electron confined to a cavity can equally well be given in terms of the electron singlet density matrix. A result of this definition of a bubble is that at finite temperature, the distinction between a bubble and delocalized state is quantitative rather than qualitative. A simplified Hamiltonian is also derived in order to investigate the existence of a bubble in helium. Dissert. Abstr.

N71-33914 Carnegie-Mellon Univ., Pittsburgh, Pa.
**TIME DEPENDENT CORRELATIONS IN LINEAR HEISENBERG CHAINS**
Robert Kian Gwan Liem (Ph.D. Thesis) 1970 124 p
Avail: Univ. Microfilms Order No. 70-9992

In the Kubo theory of linear response to external excitations, the response of a spin system is given by the equilibrium time dependent correlation functions. Using the fermion representation of the linear spin one-half Heisenberg chains, the time dependent correlations for the XY model, which corresponds to the case where the fermions are non-interacting, are calculated as functions of temperature. Their Fourier transforms in space and time, and in particular the spectral density function, are then compared to exact numerical results obtained by other authors for the full Heisenberg system. Dissert. Abstr.

N71-33915 Wisconsin Univ., Madison.
**AN INVESTIGATION OF FISSION PRODUCT BEHAVIOR AND DECAY HEATING IN NUCLEAR REACTORS**
Talmadge Ray England (Ph.D. Thesis) 1970 335 p
Avail: Univ. Microfilms Order No. 70-12727

Fission product decay heating by release of delayed beta and gamma emission is extensively studied by first principle calculations. Fissile and fissionable fuels U-235, U-233, Pu-239, U-238 and Th-232 are included. Variations in reactor dependent parameters (spectrum, flux and power level, and flux-time) are made. The calculations are sufficient for a detailed study of radiological hazards; the presented results, however, are aggregate values and are of most immediate interest in safety or reactor accident studies, and in general, for studies of fuel melting, fuel handling, or other studies where a knowledge of the fission product beta and gamma radiation is needed. Dissert. Abstr.

N71-33918 Arkansas Univ., Fayetteville.
**ELECTRON CAPTURE CROSS SECTIONS INTO THE n EQUALS 3 LEVEL OF HYDROGEN FOR 30-120 keV PROTON IMPACT ON GAS TARGETS**
Charles Arthur Strigers (Ph.D. Thesis) 1970 111 p
Avail: Univ. Microfilms Order No. 70-17190

Electron capture cross sections into the 3p and 3d states of H, by 30-100 keV proton impact on He, Ne, Ar, N2, 02, and H2, were measured. Except for He, these cross sections appear to vary within the energy range. For each individual cross section, X is a constant between 2.9 and 7.8 keV. The polarization of the H alpha radiation due to the 3p-2s and 3d-2p transitions of fast atoms formed by electron capture was measured in the same energy range. The cross sections for electron capture into the 3s state of H and D, by 30-120 keV proton and deuteron impact on these gases, were also measured. The cross sections for these two events were found to be equal for equal projectile velocities. When compared with earlier measurements of 4s cross sections, the 3s cross sections support the Born prediction that the s state cross sections should be proportional to 1/n cubed where n is the principal quantum number. Dissert. Abstr.

N71-33920 Pennsylvania Univ., Philadelphia.
**STRANGE PARTICLE FINAL STATES FROM PION(PLUS) PROTON INTERACTIONS AT 1.7 GeV/c**
Fred Leslie Forman (Ph.D. Thesis) 1969 172 p
Avail: Univ. Microfilms Order No. 70-16146

The strange particle final states from pion(+) proton interactions at an incident pion(+) momentum of 1.7 GeV/c were studied. Cross sections for all observed channels are presented. In the Sigma hyperon(+) kaon(+) channel, the model of Louie gave good quantitative agreement with the experimentally observed differential cross section and polarization. The pion(+) kaon(+) Lambda hyperon(0) channel is dominated by Y sub 1 (1385) resonance production. The resonance production and decay angular distributions are presented and compared. A new particle state was observed in the Lambda hyperon(0) pion(+) mass distribution in the pion(+) kaon(+) Lambda hyperon(0) channel at 1475 + or − 15 MeV, with a width of 30 + or −15 MeV. Three branchings ratios were determined. Dissert. Abstr.

N71-33921 Montana State Univ., Missoula.
**NUCLEAR SPIN-LATTICE RELAXATION TIME MEASUREMENTS IN Na-D3(SeO3)2**
Roy Reinhart Knispel (Ph.D. Thesis) 1970 148 p
Avail: Univ. Microfilms Order No. 70-14697

Nuclear magnetic resonance and electrical conductivity measurements were used to study the motions of hydrogen nuclei in deuterated sodium trihydrogen selenite crystals. From electrical conductivity measurements, deuteron spin-lattice relaxation time measurements, and direct deuteron interbond jump time measurements, an activation energy of 0.73 + or − 0.07 eV for deuteron interbond jumping was obtained. This motion provides the dominant contribution to the spin-lattice relaxation time above 40 C. In the temperature region from 10 C to the ferroelectric transition temperature (−25 C to −35 C in the crystals studied), a high frequency motion, such as deuteron intrabond motion, was found to dominate the spin-lattice relaxation process. The activation energy for this motion was found to be 0.055 + or − 0.01 eV. Below the ferroelectric transition, the deuteron spin-lattice relaxation time was found to be too short to be due to spin diffusion to paramagnetic impurities. Dissert. Abstr.

N71-33924# Idaho Nuclear Corp., Idaho Falls.
**MOLECULAR POTENTIAL FUNCTION IN TERMS OF GROUP VALENCE FORCE SYMMETRY COORDINATES**
H. L. Mc Murry Apr. 1971 35 p refs
(Contract AT(10-1)-1230)
(IN-1421) Avail: NTIS

A method was described for choosing coordinates for calculating vibrational potential functions of molecules which correlate closely with the symmetry properties of the molecular orbitals in

the ground state electron wave function. To illustrate the method, potential functions were obtained for C2H6 and C3H8 by transforming conventional valence force potential functions for these molecules. The constraint relations among the C2H6 force constants were apparent. For C3H8, a procedure was outlined for finding these relations and a specific application was made to illustrate the method. Author

**N71-33930** Kentucky Univ., Lexington.
**P-STATE WAVE FUNCTION OF THE TWO-ELECTRON ATOM AND THE ABSORPTION COEFFICIENT OF THE NEGATIVE HYDROGEN ION**
Richard William Postma (Ph.D. Thesis) 1969 61 p
Avail: Univ. Microfilms Order No. 70-16982

The procedure proposed is to develop a continuum state wave function to develop the bound S-state wave function. The procedure is to take the partially separated two-electron wave function and expand the function as a series in the Legendre polynomials of the cosine of the angle between the radius vectors of the two electrons. This results in explicit representation of the dependence of the wave function on all four angle variables, and leaves only the two radius variables to be determined. When the function is substituted into the Schroedinger equation and the equation is integrated over the angles, the result is a system of coupled partial differential equations of second order in the two independent variables, the radius distances to the two electrons. The singlet (symmetric) solutions are then sought by substituting difference operators for the differential operators, and applying the result to a grid of function-values. Dissert. Abstr.

**N71-33931** Brigham Young Univ., Provo, Utah.
**POLARIZATION MEASUREMENTS OF 16.5-MeV AND 22.1-MeV NEUTRONS ELASTICALLY SCATTERED FROM LIQUID TRITIUM AND LIQUID DEUTERIUM**
Roger Kenneth Walter (Ph.D. Thesis) 1970 192 p
Avail: Univ. Microfilms Order No. 70-16898

Cryogenic scattering samples of approximately one mole of liquid tritium and liquid deuterium were used in the measurement of T(n,n)T and D(n,n)D scattering. The source of 16.5-MeV, −54% polarized neutrons and of 22.1-MeV, +40% polarized neutrons was the T(d,n)4He reaction with an incident deuteron energy of 6.0 MeV. The left-right scattering asymmetries for laboratory angles from 40 deg to 118.5 deg were measured with a two-detector, time-of-flight spectrometer; and after neutron-gamma-ray discrimination was applied, the pulse height spectra were routed to an on-line computer for preliminary data analysis. The measured asymmetry for T(n,n)T at E sub n = 22.1 MeV is negative at angles forward of 95 deg (lab) and positive at larger angles. The extrema of the n-T polarizations are −60% at 85 deg (lab) and +98% at 110 deg (lab). T(n,n)T polarizations for E sub n = 16.5 MeV are negative at forward angles. D(n,n)D polarizations at E sub n = 22.1 MeV are measured to be small and negative at forward angles and small and positive at back angles. Dissert. Abstr.

**N71-33942** Texas A&M Univ., College Station.
**THE INTERMOLECULAR FORCE CONSTANTS OF HIGHLY POLAR GASES**
James Randall Johnson (Ph.D. Thesis) 1970 136 p
Avail: Univ. Microfilms Order No. 70-16736

The intermolecular force constants of methanol, ethanol, n-propanol, iso-propanol, acetone, water, ammonia, and methyl chloride were determined for six different models of the Leiden second virial coefficient - Stockmayer, polarizable dipole, dipole-quadrupole, steric, Model A, and Model B. The long-range intermolecular forces considered were the dipole-dipole interaction, the dipole-induced dipole interaction, the dipole-quadrupole interaction, and the quadrupole-quadrupole interaction. In addition to these long-range effects, the nonspherical shape of the polar molecule was considered. All models reproduced the experimental Leiden second virial coefficients well except for acetone. The potential constants were reasonable with the proper trend in the linear alcohols. The Stockmayer force parameters are different from those previously established. Dissert. Abstr.

**N71-33943** Brandeis Univ., Waltham, Mass.
**MANY BODY FORCES**
Ganesar Chanmugam (Ph.D. Thesis) 1970 113 p
Avail: Univ. Microfilms Order No. 70-17117

Electromagnetic and nuclear many body forces are discussed. A method of obtaining electromagnetic many body forces acting between elementary charged particles using a canonical transformation is described. A theory is formulated of a relativistic degenerate electron gas taking screening into account, and calculating its longitudinal and transverse dielectric constants. These may be used to determine the effects of many body forces in a relativistic degenerate plasma. The various methods used to derive nuclear many body forces and the experimental evidence for their existence are discussed. Then the effects of many body potentials on the ground state energy of a zero temperature many fermion system are determined. It is found that three body forces give significant contributions to the equation of state of a neutron star at densities less than or approximately 10 to the 15th power gm/cu cm. The effects of three body forces on various physical properties of neutron stars is briefly discussed. Dissert. Abstr.

**N71-33944** Washington State Univ., Pullman.
**THE REACTION Be-9(He-3,ALPHA,ALPHA) He-4**
David Henry Ehlers (Ph.D. Thesis) 1970 67 p
Avail: Univ. Microfilms Order No. 70-16803

Coincidence spectra of alpha particles from the reaction Be-9(He-3, alpha alpha)He-4 were measured for several angular configurations at a bombarding energy of 1.55 MeV. The spectra suggest that the final state is formed primarily by sequential processes involving intermediate states of Be-8. Angular correlations of reactions proceeding through the unresolved 16.63- and 16.94-MeV states of Be-8 and through the first excited state of Be-8 were measured. The measured angular correlations were found to be inconsistent with theoretical predictions based on resonance formation of a compound-nuclear state, and with predictions based on an initial direct reaction. An approximate treatment of the Coulomb interaction between the final-state particles indicates that the effect on the correlation due to this interaction is more pronounced than it is usually assumed to be. Dissert. Abstr.

**N71-33945** Vanderbilt Univ., Nashville, Tenn.
**A STUDY OF EVENTS WITH TWO OR FOUR CHARGED PRONGS FROM 28.5 Ge V/c PION-PION INTERACTIONS**
William Edwin Ellis (Ph.D. Thesis) 1970 123 p
Avail: Univ. Microfilms Order No. 70-16422

An 80-inch hydrogen bubble chamber was exposed to a proton beam with a momentum of 28.5 GeV/c. Approximately 83,000 pictures were taken and scanned for pp interactions with two or four charged outgoing particles. The presence of outgoing particles with high laboratory momentum made positive kinematic fitting of the events difficult. In particular, the high momentum positive tracks could be interpreted as either protons or positive pions. These difficulties were overcome by analyzing the events with neutral particles by a missing mass technique. The momentum distributions for the individual particles from several final states are presented. These include distributions of the longitudinal and transverse components of the center of mass momentum. Dissert. Abstr.

N71-33950 Yale Univ., New Haven, Conn.
**A FINE STRUCTURE MEASUREMENT IN IONIZED HELIUM**
David Lyle Mader (Ph.D. Thesis) 1969 50 p
Avail: Univ. Microfilms Order No. 70-16305

The fine structure splitting Delta E-'S' (2S1/2 - 2P3/2) in the n = 3 level of ionized helium, He+, was measured to 17 ppm with a microwave-optical technique. Here Delta E, is the fine structure interval (2P1/2 - 2P3/2) and 'S' is the Lamb shift. Electron bombardment of helium gas produces excited ions. The light from the n = 3 to n = 2 decay shows a decrease when a microwave field induces transitions among the fine structure levels. Enough data were taken to permit an extrapolation to zero gas pressure, bombarding current, and microwave power for each of the transitions alpha c and beta d, resulting in Delta E-'S' = 47843.76 + or - 0.81 (68% confidence) MHz. This value is 1.37 + or - 0.93 MHz lower than the theoretical value of 47845.13 + or - 0.46 MHz calculated with the Taylor, Parker, and Langenberg value of 1/alpha = 137.03602. If a value of 'S' is extracted from the Delta E-'S' measurement it is 0.033 + or - 0.022% higher than the current theoretical value. Dissert. Abstr.

N71-33952# Michigan Univ., Ann Arbor. Office of Research Administration.
**PHYSICS AT THE CYCLOTRON: A NONTECHNICAL DIALOGUE, VOLUME 21, NO. 12**
Jun. 1971 31 p
Avail: NTIS

The development of modern nuclear physics is briefly outlined and the use of the cyclotron in experimental research is discussed. Topics range from the discovery of the nucleus to nuclear particle interactions and nuclear force models. G.G.

N71-33953 Catholic Univ. of America, Washington, D.C.
**EVEN PARITY STATES OF THE FIVE NUCLEON SYSTEM: AN APPLICATION TO DEUTERON-TRITON PHOTO-CAPTURE**
Robert F. Wagner (Ph.D. Thesis) 1970 61 p
Avail: Univ. Microfilms Order No. 70-14155

A two particle-one hold shell model calculation was carried out for the five nucleon system. Spurious shell model states were constructed and projected out by the Schmidt orthogonalization method. The separable, smooth, two body interaction was taken as the residual force. It predicts structure in the neighborhood of 20-22 MeV which carries the preponderance of the dipole strength. The photocapture of deuterons by tritons was used to locate the dipole state of the system. A detailed calculation of the dependence of the cross section for this reaction upon energy and angle was carried out using a many level generalization of the R-matrix formalism. Dissert. Abstr.

N71-33954 Kansas State Univ., Manhattan.
**DISK SOURCE ENERGY AND ANGULAR DISTRIBUTIONS**
Richard Mark Rubin (Ph.D. Thesis) 1970 144 p
Avail: Univ. Microfilms Order No. 70-16646

Angular flux densities and exposure angular distributions for points along the axis of plane disk isotropic Co-60 sources in an infinite air medium were calculated using the moments method solution to the gamma-ray transport equation. The method is based on the expension of the gamma-ray flux density at a distance z above an infinite plane isotropic source as a Legendre polynomial expansion. The coefficients of the Legendre expansion were reconstructed using standard biorthogonal polynomial expansion techniques. Using extrapolation techniques similar to those recommended by Spencer for extrapolation of the Legendre coefficients, the exposure angular distribution was reconstructed with 61 Legendre coefficients. Standard geometric transformations allowed evaluation of exposure angular distributions for isotropic point, ring, and disk sources as well as infinite plane isotropic sources. Dissert. Abstr.

N71-33956# California Univ., Berkeley. Lawrence Radiation Lab.
**SHAKING OF PARTICLE BEAMS TO REMOVE NEUTRALIZING IONS**
J. M. Peterson Feb. 1971 3 p ref Presented at Natl. Particle Accelerator Conf., Chicago, 1 Mar. 1971
(Contract W-7405-eng-48)
(UCRL-20156; Conf-710308-9) Avail: NTIS

Positive ions produced through ionization of the residual gas by the electron beam in an accelerator or storage ring can be trapped in the potential well of the beam and produce focusing forces on the beam that can shift the betatron frequency onto a resonance or stimulate other beam-dynamics effects. At low beam intensity the ions can be removed by means of the electric field imposed by clearing electrodes; however, at high intensity clearing electrodes can become ineffective when the local field of the beam is greater than that imposed by the electrodes or even harmful because of electromagnetic interaction between the beam and the electrode system. The ions can be removed also by letting them coast to the walls in the interval during an empty gap in the beam, but the length of the necessary gap in many cases is impractical. A new method, called beam shaking, is proposed for removing the neutralizing ions by inducing increasingly larger amplitudes of ion oscillation about the beam until they are driven to the walls. Author (NSA)

N71-33967# Los Alamos Scientific Lab., N.Mex.
**MCNA: A COMPUTER PROGRAM TO SOLVE THE ADJOINT NEUTRON TRANSPORT EQUATION BY COUPLED SAMPLING WITH THE MONTE CARLO METHOD**
Leland L. Carter Aug. 1970 50 p refs
(Contract W-7405-eng-36)
(LA-4488) Avail: NTIS

A coupled sampling technique that utilizes the Monte Carlo method of solution was reported previously. This coupled sampling technique is extended to include nuclear fission and time dependence. In the coupled sampling, specific use is made of sampling from the neutron transport equation to construct a scheme for a near-optimal subsequent sampling from the adjoint neutron transport equation. This procedure may be expected to be advantageous when the phase-space volume contributing to the functional is smaller than the phase-space volume of the neutron source. The computer program MCNA was written to utilize the coupled sampling technique. MCNA uses the same neutron interaction models and cross section library as does the Los Alamos code MCN; MCN solves the transport equation with Monte Carlo. Author (NSA)

N71-33968 Ohio Univ., Athens.
**SPIN-ECHO INVESTIGATION OF ELECTRIC FIELD EFFECTS OF Pr(3 PLUS) AND Ce(3 PLUS) IN LANTHANIUM MAGNESIUM DOUBLE NITRATE**
Thomas Artz Lick (Ph.D. Thesis) 1969 153 p
Avail: Univ. Microfilms Order No. 70-15285

An experimental investigation is made of the electric field shift parameters of the rare-earth ions Pr(3+) and Ce(3+) dilutely substituted for lanthanum in La2Mg3(NO3)12.24H2O. Because this substitutional site lacks inversion symmetry, the ionic ground states are of mixed parity, and all spin Hamiltonian parameters charge linearly with applied electric field. The unit cell is centrosymmetric, so that linear shifts of opposite sign occur for the two inversion-symmetric sites. In the case of the non-Kramers ion Pr(3+), these shifts provide a direct check of the spin Hamiltonian presently used to interpret electric resonance and lineshapes, and an explicit test of the way in which zero-field splittings enter the lineshape theory. The echo technique used demonstrates the mixed magnetic-electric vector which describes the ground state double. Dissert. Abstr.

**N71-33976** Yale Univ., New Haven, Conn.
**FINE STRUCTURE MEASUREMENT OF SINGLY IONIZED HELIUM, n EQUALS 4**
Ralph Raymond Jacobs (Ph.D. Thesis) 1969 118 p
Avail: Univ. Microfilms Order No. 70-16283

Precision measurements of the energy differences 'S'4 = 4 2S1/2 - 4 2P1/2 and delta E4 - 'S'4 = 4 2P3/2 - 4S1/2 in He-4(+) are reported. The experimental results 'S' = 1768 + or − 5 MHz and delta E4 - 'S'4 = 20179.7 + or − 1.2 MHz are compared with the values determined by quantum electrodynamic theory. 'S'4 = 1768.34 + or − 0.51 MHz and delta E4 − "S'4 = 20180.78 + or − 0.56 MHz. An electron gun is operated in a section of waveguide containing helium gas. For appropriate electron energies, a process of simultaneous ionization and excitation of some atoms to He(+), n = 4 results. The electric dipole transitions 4 2'S' 1/2 yields 4 2P1/2 or 4 2S1/2 yields 4 2P3/2 cause a reduction in the intensity of 1215 A radiation which is emitted in the natural decay of 4S to 2P. This radiation passes through holes in the waveguide and is focused by an ellipsoidal light pipe onto a suitable ultraviolet detector. The resonances so obtained are fitted by various theoretical line shapes in a computerized least squares program. The resulting best fit parameters include either 'S'4 or delta E4 − 'S'4 depending on the transition studied. Dissert. Abstr.

**N71-33977#** Australian National Univ., Canberra. Dept. of Nuclear Physics.
**SPECTROSCOPIC FACTORS FROM Sn 124(d,p)Sn 125 ABOVE AND BELOW THE COULOMB BARRIER**
D. L. Powell, P. J. Dallimore, and W. F. Davidson [1970] 20 p refs
(ANU-P/511) Avail: NTIS

Angular distributions for the reaction Sn-124(d,p)Sn-125 leading to the unresolved ground and 0.026 MeV levels and to the 0.210 MeV, 0.936 MeV, 1.257 MeV, 1.362 MeV and 1.540 MeV levels of Sn-125 have been measured with deuteron energies of 5.1 and 12.0 MeV. Spectroscopic factors and transferred orbital angular momentum values were extracted using the DWBA theory. The dependence of the spectroscopic factor on the approximations of the theory was compared at energies above and below the Coulomb barrier. Author

**N71-33982#** California Univ., Livermore. Lawrence Radiation Lab.
**APPLICATION OF THE TENSOR CODE TO THE CALCULATION OF RAYLEIGH WAVES**
James A. Viecelli Jan. 1971 11 p refs Sponsored by NEC
(UCRL-50992) Avail: NTIS

Analytical methods are used to obtain two- and three-dimensional solutions for the Rayleigh wave generated by a pressure applied to the surface of an elastic half-space. The limitations inherent in the TENSOR finite-difference equation are then explored by comparing the TENSOR solutions with those derived by analytic methods. Author (NSA)

**N71-33983#** Brookhaven National Lab., Upton, N.Y.
**TABULATED DOSE UNIFORMITY RATIO AND MINIMUM DOSE DATA FOR GAMMA IRRADIATOR DESIGN**
F. X. Rizzo, L. Galanter, and K. Krishnamurthy Dec. 1970 122 p refs Sponsored by AEC revised
(BNL-50145-Rev) Avail: NTIS

Dose uniformity ratios and minimum dose data in cobalt-60 and cesium-137 rectangular source irradiators are tabulated. The tabulated data supplies dose distribution information to the irradiator designer, permitting a quick and easy approximation to be made of the performance of most gamma irradiators which utilize rectangular sources and targets. The data in the tables are computer calculated values of the uniformity ratios, U (maximum dose/minimum dose), and the minimum doses in multipass irradiators. Data for two, four, and six pass irradiator systems are presented for typical target materials and rectangular plaque sources over a wide range of sizes. Source-to-target air gap was treated as a variable since this correction is considered to be more difficult to perform. Author (NSA)

**N71-33984#** Laboratory de Physique Theorique et des Hautes Energies, Orsay (France).
**MATTER ANTIMATTER HYDRODYNAMICS: THE COALESCENCE EFFECT**
R. Omnes May 1971 33 p refs
(Rept-71/25) Avail: NTIS

The hydrodynamical motion of a system consisting of matter and antimatter embedded in thermal radiation is investigated. These motions are generated by the pressure which is due to the annihilation products and by thermal convection which transports the energy released by annihilation. It is shown that the Leidenfrost effect is compensated by the gradients of the radiative pressure, so that thermal convection is dominant and its velocity can be simply written. These results are obtained under the physical conditions which are assumed to take place during the radiative period in a matter-antimatter Universe. The coalescence of matter systems into regions having a size of the order of the mean free path for high energy photons is established for simple cases. Author

**N71-33985#** Royal Aircraft Establishment, Farnborough (England).
**THE DEPENDENCE ON RADIATION INTENSITY OF THE FADING OF LATENT IMAGES EXPOSED BY LIGHT AND GAMMA RADIATION [DAS FADING BEI-LICHT- UND GAMMA-BESTRAHLUNG IN ABHAENGIGKEIT VON DER STRAHLUNGSINTENSITAT]**
J. Eggers et al Apr. 1971 19 p refs Transl. into ENGLISH from Photogr. Korresp. (Austria), v. 101, no. 3, 1965 p 42–47
(RAE-LIB-TRANS-1573) Avail: NTIS

The fading of external and internal latent image nuclei produced by light or gamma radiation from very small to moderate radiation intensities is reported. Both in the case of light and gamma radiation, the fading at low intensities was greater than at moderate intensities. Curves obtained using light radiation show that the intensity dependence of fading was particularly strong in the case of internal latent image nuclei. The kinetics of fading can be explained on the basis of the assumption that internal latent image nuclei consist not only of a stable component, but also of a mobile one which, in the first period of fading, migrates from within the grain to the grain surface and there delays the disappearance of external latent image nuclei. Fading of the external latent image nuclei occurs more strongly as soon as the mobile internal latent image nucleus disappears. Author

**N71-33987#** Chicago Univ., Ill.
**MASS YIELD AND CHARGE DISTRIBUTION IN 450 MeV PROTON FISSION OF U 238**
John A. Panontin and Nathan Sugarman [1970] 24 p refs Sponsored by AEC
(GOO-1167-10) Avail: NTIS

The independent and/or cumulative cross sections of 26 isotopes of silver, cadmium, indium, tin, and antimony from the fission of U-238 with 450-MeV protons were measured. The isotopic yield distribution for these elements are presented along with the charge distribution for five mass chains, 115, 117, 125, 127, and 129. The values of the most probable charge, Zp, for fourteen mass chains were calculated and the variation of A/Zp with A defined for the mass region, 100 to 130. For A values between 100 and 120, A/Zp and the charge distribution width are relatively constant at values of 2.424 + or − 0.004 and 2.90 + or − 0.10 Z units, respectively. In the mass region, 125 to 129, a width of

3.21 Z units and a slightly higher value of A/Zp, 2.430 + or − 0.004, are required to account for the data. A mass yield curve encompassing this region of A was also calculated.
Author (NSA)

**N71-33989#** Florida State Univ., Tallahassee.
**AN EXPERIMENTAL STUDY OF NUCLEAR MODELS. 1: DECAY SCHEMES AND NUCLEAR REACTIONS Progress Report, 1 Aug. 1970 – 31 Jul. 1971**
Raymond K. Sheline 1971 30 p refs
(Contract AT(40-1)-2434)
(ORO-2434-1) Avail: NTIS

Shell-model states were investigated in the nuclei La-139, La-140, Ce-141, and Bi-210. Levels were studied in the transitional nucleus Ru-106 and the deformed nuclei Tb-158, Gd-158, Ho-164, Lu-175, and Lu-177. Theoretical work was done on the neutron-proton interaction in deformed odd – odd nuclei. An infrared study of the trimetallic carbonyls and anisotropic chemical shifts is included.
NSA

**N71-33991#** Sandia Corp., Albuquerque, N.Mex.
**NEUTRON DAMAGE EFFECTS IN STEP RECOVERY DIODE FREQUENCY MULTIPLIERS**
R. J. Chaffin Apr. 1971 45 p refs Sponsored by AEC
(SC-RR-710188) Avail: NTIS

The Step-Recovery Diode frequency multiplier has been studied both theoretically and experimentally. The results show that the multiplier is quite susceptible to neutron damage if self-bias is used (which is usually the case), and it is recommended either that the preradiation lifetime should be deliberately shortened or that voltage bias be considered in a radiation environment. The self-bias problem is found to be due to an increase in recombination current brought on by a reduction in minority carrier lifetime with neutron fluence. This study also derives the ultimate failure fluence as a function of multiplier parameters for these multipliers in general.
Author (NSA)

# 25 PHYSICS, PLASMA

Includes magnetohydrodynamics. For applications see: 28 Propulsion Systems.

**N71-32861#** Kyoto Univ. (Japan), Nara Technical Coll. (Japan). Dept. of Aeronautical Engineering.
**STRUCTURE OF NONEQUILIBRIUM BOUNDARY LAYER ALONG A FLAT PLATE IN A PARTIALLY IONIZED GAS**
Michio Nishida and Kazuoki Matsuoka 1970 38 p refs Backup document for AIAA Synoptic scheduled for publication in AIAA Journal Prepared in cooperation with Nara Tech. Coll.
(NTC-45-6; Rept-70-1) Avail: NTIS

The structure of a nonequilibrium, partially ionized boundary-layer which is developed along a flat plate at floating potential is described. The boundary conditions at the wall for electron temperature and mass fraction of electron-ion pairs are determined from the conditions for the continuities of electron energy flux and ion mass flux at the outer edge of the sheath and the zero net current at the wall. Solutions obtained for a chemically frozen flow show that electron temperature is significantly different from atom-ion temperature and that the thickness of boundary-layer for electron temperature is much thicker than that of boundary-layer for atom-ion temperature.
Author

**N71-32916#** Aerospace Research Labs., Wright-Patterson AFB, Ohio.
**NUMERICAL TREATMENT OF THE AXISYMMETRIC COLUMN OF A GAS DISCHARGE FOR INTERMEDIATE AND HIGH PLASMA DENSITIES Final Report**
Karl G. Guderley and E. Marian Valentine Jan. 1971 83 p refs
(AD-724112; ARL-71-0013) Avail: NTIS CSCL 20/9

At intermediate and high plasma densities, the positive column of a gas discharge is governed by a two point boundary value problem for a stiff system of ordinary differential equations. A method to isolate the stiff components is shown. It avoids the drawback of the approach used for the slab symmetry, i.e. the representation is applicable at the axis of symmetry. The key is a transformation of the equations based on asymptotic particular solution of the homogeneous linearized system, which are found by inspection. The method, although simple in its concept, requires a considerable amount of analytic preparation and rather cumbersome programming. In the slab problem it is more convenient (but perhaps less systematic) than the approach used previously. The present method, as that for slab symmetry, will not deteriorate for high plasma densities. Some examples have been computed. The asymptotic expansions, which are taken as starting approximations, are surprisingly good even for fairly low plasma densities.
Author (GRA)

**N71-32920#** Polytechnic Inst. of Brooklyn, Farmingdale, N.Y. Dept. of Aerospace Engineering and Applied Mechanics.
**FLUSH ELECTROSTATIC PROBE IN A CONTINUUM REGIME**
Samuel Lederman and Robert Bushman Dec. 1970 39 p refs
(Contract DAHC04-69-C-0077; ARPA Order 1442)
(AD-724148; PIBAL-70-54) Avail: NTIS CSCL 20/9

The effects of area, geometry and applied bias upon the current collection of negatively biased flush electrostatic probes is experimentally investigated in a continuum regime. The effects of area, geometry and applied bias were found to be strongly interrelated and their influence on the collected ion current density very complex. It is found, in general, that the ion current increases with increasing probe bias but decreases with increasing probe area.
Author (GRA)

**N71-33029#** Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Porz (West Germany). Inst. fuer Angewandte Gasdynamik.
**MAGNETOPLASMADYNAMIC FLOW THROUGH A CYLINDRICAL CHANNEL WITH HALL EFFECT [MAGNETOPLASMADYNAMISCHE ROHRSTROEMUNGEN MIT HALL-EFFEKT]**
Klaus Robert (Ph. D. Thesis – Tech. Univ. Berlin) Oct. 1970 86 p refs In GERMAN; ENGLISH summary
(DLR-FB-70-50) Avail: NTIS; ZLDI Munich: 24.80 DM

The steady isothermal inviscid flow of an ionized gas through a nonconducting cylindrical channel of semi-infinite length under the influence of an axial electric field and a variable, axisymmetric external magnetic field is investigated threedimensionally. After nondimensionalizing, the fundamental equations of magnetogasdynamics are linearized. The resulting equations are integrated in closed form.
ESRO

**N71-33156#** Office of Naval Research, London (England).
**RESEARCH IN PLASMA PHYSICS AND CONTROLLED THERMONUCLEAR FUSION IN PARIS AND ITS ENVIRONS**
Howard H. C. Chang 30 Apr. 1971 43 p refs
(AD-724291; ONRL-R-10-71) Avail: NTIS CSCL 20/9

In the report, a brief account is given of a five-day visit made in the summer of 1970 to several laboratories and universities engaged in research in plasma physics and controlled thermonuclear fusion (CTF) in Paris and its environs: the Plasma Physics and Controlled Fusion Department at Fontenay-aux-Roses, the Laboratory of the Physics of Ionized Media of the Ecole polytechnique and the Plasma Physics Laboratory of the Faculty of the Sciences at Orsay.
Author (GRA)

N71-33446*# Avco-Everett Research Lab., Everett, Mass.
**RESEARCH PROGRAM IN PLASMA PHYSICS Final Report**
Mar. 1971 19 p refs
(Contract NASw-2040)
(NASA-CR-121437) Avail: NTIS CSCL 20I

Results of a plasma physics research program on collisionless shock waves and barium cloud dynamics are reported. Several factors which influence the linear stability of barium ion clouds were investigated including the stability as a function of position around the cloud, and the stabilization provided by the presence of a conducting E region. Some analytic work on the nonlinear equations provided some insight into the steepening of the backside of barium ion clouds and the development of magnetic-field-aligned sheets hanging back from the ion cloud in the direction of the neutral cloud. An annotated bibliography of the work done was given and two reports, Plasma Cloud Striations, and Collisionless Shocks in Plasmas, contained the principle results of this research and were included in this final report. Author

N71-33476# Office National d'Etudes et de Recherches Aerospatiales, Paris (France).
**DISCHARGE OF HOLLOW CATHODE INTERNAL FLOW CONDITIONS IN THE CATHODE [DECHARGE A CATHODE CREUSE. CONDITIONS DE L'ECOULEMENT A L'INTERIEUR DE LA CATHODE]**
Andre Brunet 1971 5 p refs In FRENCH; ENGLISH summary
Presented at the Colloq. de la Soc. Francaise de Phys., Evian, 25–29 May 1971
(TP-959) Avail: NTIS

It is shown that the heat supplied by the cathode walls to the operational regime of the internal positive gas column is so great that thermal choking develops. At this moment, the upstream flow temperature is at a maximum at the cathode end where a sonic throat exists. Author

N71-33500*# Maryland Univ., College Park. Inst. for Fluid Dynamic and Applied Mathematics.
**COMMENTS ON ION-ACOUSTIC SOLITARY WAVES IN PLASMAS**
C. S. Wu, R. T. Taussig (Columbia Univ. N.Y.), and C. K. Chu (Columbia Univ., N.Y.) 1971 9 p refs
(Grant NGL-21-002-00517; Contract AT(30-1)-3954)
(NASA-CR-121448) Avail: NTIS CSCL 20I

It was first shown by Sagdeev that ion sound solitary waves can occur in a plasma with cold ions and hot electrons. Later Washimi and Tanuiti showed that the Korteweg-deVries equation can be derived for the problem of ion sound wave disturbances moving with velocity slightly greater than the ion sound speed in a homogeneous plasma free of external field. Consequently, steady state solution for ion sound solitary wave was again demonstrated by these authors. The theoretical prediction of the existence of ion sound solitary wave has attracted a great deal of attention in recent years since the subject is highly relevant to the theory of collisionless shock waves. Some basic conceptual difficulties associated with these earlier derivations were discussed and a more accurate picture of the essential physics involved was proposed. Author

N71-33635*# Oak Ridge National Lab., Tenn.
**EXPLORATORY PLASMADYNAMIC STUDIES OF VORTEX AND COAXIAL FLOW GEOMETRIES EMPLOYING RADIOFREQUENCY INDUCTION HEATING**
J. J. Keyes, Jr. and W. K. Sartory *In* Florida Univ. Res. on Uranium Plasmas and Their Technol. Appl. 1971 p 71–82 refs
Sponsored by AEC (See N71-33626 20-22)
Avail: SOD $3.75; NTIS CSCL 20I

Experiments are described in which the effect of high energy density, volumetric heating on jet-driven vortex flow of argon and on coaxial flow of helium and argon were determined. The plasmas were heated inductively at atmospheric pressure to peak temperatures estimated to be between 10,000 and 15,000 K. Experiments with vortex tubes revealed that significant increase in the ratio of tangential velocity to injection velocity is effected when the argon gas is heated to plasma conditions. A superconducting magnet capable of generating reasonably uniform axial magnetic flux densities of up to 2.3 W/sq m is described. Initial coaxial-flow studies using a 2-in.-diam. quartz outer tube for helium and a 1 1/4-in.-diam graphite injection tube for argon resulted in a positive correlation of magnetic flux density and coupling between the radiofrequency field and the positive correlation of magnetic flux density and coupling between the radiofrequency field and the plasma. It is suggested that the magnetic field increases the effective argon concentration in the plasma. Author

N71-33640*# Massachusetts Inst. of Tech., Cambridge.
**AN ACOUSTIC INSTABILITY DRIVEN BY ABSORPTION OF RADIATION IN GASES**
Michael J. Monsler (AVCO-Everett Res. Lab.) and Jack L. Kerrebrock *In* Florida Univ. Res. on Uranium Plasmas and Their Technol. Appl. 1971 p 135–137 (See N71-33626 20-22)
(Grant NGR-22-009-019)
(CSR-T-69-4) Avail: SOD $3.75; NTIS CSCL 20I

Previous work on fluctuations in a radiating gas is extended to include an opacity which is a function of temperature and pressure and, most importantly, to include a net radiative heat flux and gradients in the thermodynamic variables. These extensions allow the investigation of an instability driven by the absorption of radiation by waves in the gas. The effect of this will be to limit the maximum possible net radiative heat flux in a problem to a value which can be substantially lower than that predicted by the usual steady state heat transfer analysis. Author

N71-33642*# Los Alamos Scientific Lab., N.Mex.
**CURRENT STATUS OF THE ANALYSIS OF THE OPTICAL SPECTRA OF URANIUM**
D. W. Steinhaus, L. J. Radziemski, Jr., and R. D. Cowan *In* Florida Univ. Res. on Uranium Plasmas and Their Technol. Appl. 1971 p 151–163 refs Sponsored by AEC (See N71-33626 20-22)
Avail: SOD $3.75; NTIS CSCL 20I

New high-resolution spectroscopic systems and rapid precision data-reduction techniques are being used to produce a new description of the uranium spectra. The present line list contains information on about 25,000 lines, of which 13,000 have a wave number accuracy better than 0.01/cm. About 10,100 lines were classified to 1050 levels of U I and U II, but only a few of the levels were assigned to an electron configuration. Some theoretical calculations were made of the energy level structure of the low-lying configurations of U I through U VI. Agreement with known experimental levels of U I and U II is reasonably good for the lower levels. These calculations lead to ionization potentials for U I through U V which are, respectively, 6.22 + or − 0.5, 10.6 + or − 1, 18.9 + or − 1, 32.1 + or − 2, and 47.1 + or − 2 V. Author

N71-33646*# Florida Univ., Gainesville.
**SPECTROSCOPIC STUDY OF A URANIUM ARC PLASMA**
H. D. Campbell, R. T. Schneider, C. D. Kylstra, and A. G. Randol, III (Nucl. Fuel Serv., Inc.) *In its* Res. on Uranium Plasmas and Their Technol. Appl. 1971 p 187–195 refs (See N71-33626 20-22)
(Grant NGR-10-005-089)
Avail: SOD $3.75; NTIS CSCL 20I

Measurements of temperatures, particle densities, emission, and absorption coefficients of a uranium arc are reported. The motivation for the research was to acquire fundamental knowledge of the physical properties of uranium plasmas which will, in turn, eventually lead to the design of a self-sustaining fissioning plasma.

The arc is generated in a high-pressure cell capable of withstanding pressures of up to 100 atm. The current passes between a tungsten pin cathode and a uranium pellet anode. A cover gas of helium is used and substantial vaporization of uranium takes place as the pellet temperature rises and the arc stabilizes. The atomic characteristics of the helium and uranium are such that the emitted line radiation originates primarily from singly ionized uranium. Spectroscopic diagnostics were used throughout the investigation. Several methods of temperature determination were employed, including Boltzmann plots, relative line intensities, and brightness emissivity methods. Although there are difficulties associated with each method, all temperature measurements were found to lie in the range of 7500 to 12,000 K. The measurements of emission and absorption coefficients of the plasma were taken over the pressure range of 3 to 15 atm and current range of approximately 15 to 50 A. The corresponding partial pressure of uranium over this range was estimated to be 0.1 to 0.5 atm. Author

**N71-33647*#** Maryland Univ., College Park. Inst. for Fluid Dynamics and Applied Mathematics.

**URANIUM PLASMA OPACITY MEASUREMENTS**

M. H. Miller, T. D. Wilkerson, and D. W. Koopman *In* Florida Univ. Res. on Uranium Plasmas and Their Technol. Appl. 1971 p 197–204 refs (See N71-33626 20-22)

(Grant NGR-21-002-167)

Avail: SOD $3.75; NTIS CSCL 20I

Absolute opacities of uranium plasma (2800 to 8800 A) are measured by using a gas-driven shock tube. Temperatures (7500 to 12,000 K) and partial pressures (1/50 to 1/5 atm) approach those anticipated at the hydrogen-uranium interface of proposed gaseous-core nuclear reactors. At these conditions uranium (U I, U II, and U III) is essentially the only spectroscopically active constituent of shock tube test gases composed of 0.2 to 2.0 percent UF 6 in neon. Absolute opacities at 5000 A are measured photoelectrically both in emission and in absorption. Time-resolved photographic recording was used to determine the variation of opacity with wavelength. Visible opacities are two to five times smaller than those of theoretical predictions, the variance depending on plasma state. The relative contribution to the opacity from the continuum appears to be tenfold greater than that predicted. The variation of opacity with wavelength was found to fit theory well between 4000 and 8800 A, but observed opacities decreased rapidly in the uv range, whereas theory predicts that they should increase strongly. Author

**N71-33648*#** Florida Univ., Gainesville.

**GENERATION OF A FISSIONING PLASMA**

C. D. Kylstra and R. T. Schneider *In its* Res. on Uranium Plasmas and Their Technol. Appl. 1971 p 205–209 refs (See N71-33626 20-22)

Avail: SOD $3.75; NTIS CSCL 20I

Measurements of the radiation emission properties of a uranium plasma were made on thermally excited plasmas. Attempts were also made to determine what fraction of fission energy is emitted from the plasma as nonequilibrium radiation as compared with the amount of fission energy deposited by heating up the plasma, and what the spectrum of the nonequilibrium radiation is. The instruments used and the problems associated with such measurements are also discussed. E.H.W.

**N71-33649*#** Aerospace Research Labs., Wright-Patterson AFB, Ohio.

**INVESTIGATION OF ARC PLASMA AT EXTREMELY HIGH PRESSURES**

Uwe H. Bauder and Erich E. Soehngen *In* Florida Univ. Res. on Uranium Plasmas and Their Technol. Appl. 1971 p 211–215 refs (See N71-33626 20-22)

Avail: SOD $3.75; NTIS CSCL 20I

Some aspects of the high pressure plasma research program are described. This program is concerned with studies of electric arc discharges in selected gases at pressure levels up to 1000 atm. Under the initial phase transport properties of argon at pressures up to 150 atm are being determined. The method involves measurements of the integral arc parameters and of the radial temperature distribution from which the electrical and thermal conductivities as well as the radiation source strength of the plasma may be determined as a function of temperature and pressure. The test facility and the measurement technique are described and first results obtained with argon are presented. Extension of the method to measurements in gas mixtures containing uranium vapor appears feasible. Author

**N71-33674** Texas A&M Univ., College Station.

**INVESTIGATION OF A THREE COMPONENT PLASMA STREAMING INTO A DIPOLE MAGNETIC FIELD**

Donald David Miller (Ph.D. Thesis) 1970 118 p

Avail: Univ. Microfilms Order No. 70-16746

Thomson scattered laser light was used to determine time resolved electron temperature and density as a hydrogen plasma, with helium and argon ions in 25 and 10% concentrations, drifted into a dipole magnetic field. Doppler broadening of the H-alpha line yielded data on the hydrogen ion temperature. The plasma was not trapped and was monitored while drifting through the dipole cusp. A two phase plasmoid model was proposed in order to explain the behavior of the observed densities and temperatures. A given plasmoid was followed from its initiation until it passes the observation point while undergoing a collisionless transfer of directed ion energy to cyclotron energy due to the magnetic field gradient and then thermalizing through coulomb collisions. Calculations using this model approximated the observed behavior and the trends pertinent to the effect of the heavy ions added as impurities. Dissert. Abstr.

**N71-33761#** Office National d'Etudes et de Recherches Aerospatiales, Paris (France).

**A LABORATORY SIMULATION OF THE IONOSPHERIC PLASMA [SIMULATION EN LABORATOIRE DU PLASMA IONOSPHERIQUE]**

Daniel Pigache 1971 6 p refs Presented at 4th Conf. AIAA Sur La Dynamique Des Fluides Et Des Plasmas, Palo Alto, Calif., 21-23 Jun. 1971

(TP-951) Avail: NTIS

An exact simulation of satellite motion in the ionospheric plasma was obtained in a large vacuum chamber by means of a synthetized plasma stream produced by a low energy and high current-density ion source. The maximum current density extracted from the source was 4 mA/sq cm for 20 eV argon ions. The electron velocity distribution was Maxwellian and the temperature could be varied between 500 and 2000 K. The low electron temperature implied a cooling process which was successfully explained. The plasma wind-tunnel is being used for fundamental studies on the wake structure and for testing ionospheric probes. Author

**N71-33766** Minnesota Univ., Minneapolis.

**THE EFFECT OF IONIZATION ON HEAT TRANSFER TO WIRES IMMERSED IN AN ARC PLASMA**

Thomas Walter Petrie (Ph.D. Thesis) 1969 221 p

Avail: Univ. Microfilms Order No. 70-15790

The local heat transfer to a solid body immersed in a highly ionized gas in local thermodynamic equilibrium (LTE) is measured by sweeping wire probes through the plasma of a high intensity, free-burning arc in argon at atmospheric pressure. Heating of the wire material used increases its electrical resistivity. This, in turn, results in an increased voltage drop across a wire when a constant current passes through a fixed length of it. As a wire is swept through the plasma, this voltage drop indicates the heat transferred

to the entire wire. The history of the voltage drop across the wire is recorded with an oscillograph as a function of the wire's position in the plasma and forms the raw experimental data. The raw data are prepared for internal consistency by assuming an arbitrary heat transfer situation and calculating the probe response. This response forms the input to the program. The resulting output agrees reasonably well with the assumed input. Dissert. Abstr.

**N71-33817** Cornell Univ., Ithaca, N.Y.
**SHOCK WAVES IN A COLLISION FREE MAGNETOPLASMA**
William Henry Evers, Jr. (Ph.D. Thesis) 1970 196 p
Avail: Univ. Microfilms Order No. 70-14380

Planar magnetoplasmadynamic disturbances, propagating exactly perpendicular to the magnetic field in a warm, collision-free plasma, were studied by solving numerically the equations of motion appropriate to the one dimensional magnetic piston problem. The present analysis considers plasmas with initial ion temperatures such that neutral beta sub i equal to 0.05 to 0.50 and presents the results in terms of ion fluid properties. For neutral beta sub i identical to 0, Altven-Mach numbers sufficiently less than two and short enough times, no ion multistreaming occurs anywhere in the flow. For either neutral beta sub i identical to 0 and Alfven-Mach numbers sufficiently greater than two or neutral beta sub i not = to 0 and Mach numbers sufficiently greater than one, ion multi-streaming starts immediately at the disturbance front. The turbulent, shock-like disturbances heat only the ions irreversibly, giving a Maxwellian distribution of particle energies, and exhibit relations between the upstream and downstream values of the plasma and field variables which agree with the appropriate Rankine-Hugoniot equations. Dissert. Abstr.

**N71-33838#** Office National d'Etudes et de Recherches Aerospatiales, Paris (France).
**COLLISIONLESS PLASMA SHEATH AROUND A CYLINDER [ECOULEMENT DE PLASMA SANS COLLISIONS AUTOUR D'UN CYLINDRE]**
Gerard Fournier 1971 3 p refs In FRENCH; ENGLISH summary
Presented at Colloques de la Societe Francaise de Physique, Evian, 25-29 May 1971
(TP-958) Avail: NTIS

The stationary collisionless plasma sheath around a conducting cylinder is analyzed in the absence of magnetic effects. The Vlasov-Poisson equations are solved by a non-restrictive hybrid calculation. Results show that there is no more sheath around the cylinder when positively biased. Simulation experiments qualitatively agree with theoretical expectations. Author

**N71-33865** Florida Univ., Gainesville.
**A DETERMINATION OF HIGH PRESSURE, HIGH TEMPERATURE URANIUM PLASMA PROPERTIES**
Arthur G. Randol, III (Ph.D. Thesis) 1969 201 p
Avail: Univ. Microfilms Order No. 70-14913

An experiment is devised and constructed to study the properties of a high pressure uranium plasma. The plasma is generated in the column of a direct current, electrical arc. Electrical power input to the arc ranges between 0.3 kilowatts and 1.7 kilowatts. Helium is the cover gas which provides operating pressures between 1.0 and 11.6 atmospheres. An analytical study of the effects of pressure and temperature on the plasma intensity profile is made. From the results of this study correction criteria for Boltzmann Plot temperature determinations are developed. Predictions of uranium number densities from considerations of anode vaporization are made. Dissert. Abstr.

# 26 PHYSICS, SOLID-STATE

**Includes semiconductor theory; and superconductivity. For applications see: 16 Masers. For related information see also: 10 Electronics.**

**N71-32928#** Utah Univ., Salt Lake City. Dept. of Physics.
**ELECTRONIC AND RADIATION DAMAGE PROPERTIES OF RUTILE Technical Report, 1 Jun. 1970-31 May 1971**
John W. De Ford, Owen W. Johnson, and Franz Rosenberger 31 May 1971 45 p refs
(Contract DAHC15-70-G-13; ARPA Order 1610)
(AD-724311) Avail: NTIS CSCL 20/12

A new mechanism to account for the anomalously large dielectric loss and apparent dielectric constant frequently observed in TiO2 is presented, which appears to agree well with experiment. The mechanism involves field-induced donor migration, resulting in a large decrease in electronic resistivity in part of the crystal. Experimental results on a variety of crystals are discussed, and the influence of electrode materials, surface condition, heat treatment and ambient is analyzed. A method for numerically calculating the resistivity profile of such a crystal from dielectric loss data is described. Results indicative of room temperature p-type conductivity, and a voltage-induced conduction process are presented. Author (GRA)

**N71-32965#** Lincoln Lab., Mass. Inst. of Tech., Lexington.
**SOLID STATE RESEARCH, 1971 Quarterly Technical Summary Report, 1 Nov. 1970-31 Jan. 1971**
Alan L. Mc Whorter 15 Feb. 1971 66 p refs
(Contract F19628-70-C-0230)
(AD-724074; ESD-TR-71-20) Avail: NTIS CSCL 20/12

The report covers in detail the solid state research work of the solid State Division at Lincoln Laboratory for the period 1 November 1970 through 31 January 1971. The topics covered are Solid State Device Research, Materials Research, Physics of Solids, and Microelectronics. The Microsound work is sponsored by ABMDA and is reported under that program. Author (GRA)

**N71-32995#** Emmanuel Coll., Boston, Mass. Oriental Science Research Library.
**ON THE WURTZITE-TYPE SiC WHISKERS OBTAINED BY SUBLIMATION AND THE THERMAL STABILITY OF BASIC SiC POLYTYPES**
Yoshizo Inomata et al 17 Mar. 1971 23 p refs Transl. into ENGLISH from Yogyo Kyokai Shi (Tokyo), v. 78, no. 4, 1970 p 133-138
(Contract F19628-68-C-0251)
(AD-724103; EMM-70-262; AFCRL-71-0172; AFCRL-TRANS-90) Avail: NTIS CSCL 20/2

H-type SiC whiskers were obtained using the sublimation method. Based on the results of heating a powdered mixture of high-purity silicon and graphite, the thermal stability of basic SiC polytypes is discussed. The conlusions are summarized as follows: Beta-SiC crystals grow in the entire temperature range under conditions of high supersaturation. The initial phase which appears from heating Beta-SiC is mainly 6 H above 1,600 C and 4 H or 2 H below 1,400 C 2 H, 3 C, and 6 H are stable in the range below 1,400 C, 1,400-1,600 C, 1,600-2,100 C, and above 2,100 C, respectively. 15 R is unstable throughout the entire temperature range. Author (GRA)

**N71-33017** Illinois Univ., Urbana. Dept. of Metallurgy and Mining Engineering.
**ULTRASONIC ATTENUATION IN GERMANIUM AT ROOM TEMPERATURE**
Richard F. Mattas and Howard K. Birnbaum Jun. 1971 44 p refs
(Contract N00014-67-A-0305-0016)
(AD-724328) Avail: NTIS CSCL 20/12

The effect of dislocations on the acoustic attenuation of n, p and intrinsic germanium was determined at 300K. The frequency range studied was 30 to 310 MHz. In the undeformed germanium the attenuation was explained by an Akheizer

mechanism. Introduction of dislocations resulted in a small increase of attenuation which increased with frequency and did not depend on the doping level of the germanium. The increase in attenuation was compared with various mechanisms; kink motion along dislocations, the vibrating string model, and phonon scattering from the dislocations. Author (GRA)

N71-33045# Rome Univ. (Italy). Inst. of Physics.
**MACROSCOPIC COHERENCE EFFECTS IN SUPERFLUIDS: SOME THEORETICAL ASPECTS**
C. Di Castro 17 Sep. 1970 97 p refs Presented at the Intern. School of Appl. Phys., Erice, Italy, 11-27 Apr. 1969 *Its* Nota Interna No. 284
Avail: NTIS

Macroscopic theories are introduced to explain cohesion effects in superfluids such as liquid helium and liquid superconductors. The microscopic analogies of these theories are discussed, and the second quantization representation is used. ESRO

N71-33046# Emmanuel Coll., Boston, Mass. Oriental Science Research Library.
**EFFECT OF ALUMINUM DOPING ON THE THERMAL STABILITY OF 4H- AND 6H-SiC**
Mamoru Mitomo et al 17 Mar. 1971 23 p refs Transl. into ENGLISH from Yogyo Kyokai Shi (Tokyo), v. 78, no. 7, 1970 p 224-228
(Contract F19628-68-C-0251)
(AD-724102; EMM-70-263; AFCRL-71-0171; AFCRL-TRANS-89) Avail: NTIS CSCL 20/2

The effect of aluminum doping on the thermal stability of basic SiC polytypes was studied experimentally in the range 2,000-2,400C. The doping was performed by adding alumina to a mixture of powdered silicon and carbon. The relative amount of 4H increased with increasing content of aluminum in the SiC powder. The same aluminum effect was shown when high-purity alpha-SiC was used. The stability of the 4H structure by aluminum doping was attributed to lattice distortion. The 15R-type was found quasi-stable under these conditions. Author (GRA)

N71-33099# International Business Machines Corp., Yorktown Heights, N.Y. Watson Research Center.
**SURFACE WAVES IN SOLIDS Final Report, Mar. 1970-28 Feb. 1971**
E.G. Lean Apr. 1971 56 p refs
(Contract N00014-69-C-0222)
(AD-724338) Avail: NTIS CSCL 20/12

The document discusses the results of the experimental and theoretical investigations of surface acoustic waves propagating on piezoelectric substrates. It includes the parametric interactions, harmonic generation, parametric mixing of surface acoustic waves, interactions between light and surface acoustic waves, and the excitation of acoustic surface waves by a grating coupled Gunn oscillator. The accomplished results are reported in four papers entitled (1) Harmonic generation of Rayleigh waves in LiNbO3 substrates with a thin film, (2) Nonlinear interaction of surface waves with pseudo-surface waves, (3) The light diffraction efficiency of acoustic surface waves, (4) Excitation of acoustic surface waves with a grating coupled Gunn oscillator. Author (GRA)

N71-33154# Office of Naval Research, London (England).
**SOME LOW AND ULTRALOW TEMPERATURE RESEARCH AT THE UNIVERSITIES OF SUSSEX, CAMBRIDGE, AND BIRMINGHAM**
Robert A. Hein 26 Apr. 1971 21 p refs
(AD-724633; ONRL-R-13-71) Avail: NTIS CSCL 20/12

The report describes some of the low temperature and ultra-low temperature research being done at the University of Sussex, University of Cambridge and the University of Birmingham. The main emphasis of the report is on superfluid helium and superconductivity. Author (GRA)

N71-33293# Eidgenossische Technische Hochschule, Zurich (Switzerland).
**EXPERIMENTAL STUDY OF LEAD LATTICE DYNAMICS [EXPERIMENTELLE UNTERSUCHUNG DER GITTERDYNAMIK VON BLEI]**
Albert Furrer (Ph.D. Thesis) 1970 85 p refs In GERMAN
(DISS-4497) Avail: NTIS

A rotating crystal time-of-flight spectrometer with coherent inelastic neutron scattering was used to measure phonon dispersion of lead in a (110)-level at 5 K, 80 K, and 290 K. Time-of-flight spectral analyses established a complex shift of phonon frequencies as function of temperature that was attributed to phonon-phonon exchange effects. An additional shift was triggered by temperature independent phonon-electron exchange effects that dominate at 5 K. Transl. by G.G.

N71-33314# Army Electronics Command, Fort Monmouth, N.J.
**COMPUTER PROGRAMS TO EVALUATE SEMICONDUCTOR MATERIALS IN CONJUNCTION WITH SCHOTTKY BARRIERS**
Kenneth L. Klohn Mar. 1971 33 p refs
(AD-724106; ECOM-3407) Avail: NTIS CSCL 20/12

The report presents two computer programs written in Fortran computer language for use on remote access teletype terminals which can be used to calculate the impurity doping profiles of semiconductor materials. These programs are used in conjunction with capacitance-voltage measurements on rectifying Schottky barrier contacts. The basic mathematical equation used in the calculations are derived and the program logic is discussed. One program uses curve fitting techniques to obtain a polynomial which produces a best-fit curve to the data by employing a least squares criterion. The second program is based on differential capacitance voltage measurements to make point-by-point calculations of carrier concentration and depth. The advantages and disadvantages of each technique are discussed. Author (GRA)

N71-33398*# National Bureau of Standards, Washington, D.C. Electronic Technology Div.
**METHODS OF MEASUREMENT FOR SEMICONDUCTOR MATERIALS, PROCESS CONTROL, AND DEVICES Quarterly Report, 1 Oct.-31 Dec. 1970**
W. Murray Bullis, ed. Aug. 1971 73 p refs Supported in part by AEC and NBS
(NASA Order S-70003-G; NASA Order H-76553A; DASA Order EA017-801; NAVY Order PO-1-0030; NAVY Order PO-1-0041 et al)
(NASA-CR-121459; NBS-TN-592; QR-10) Avail: SOD $0.50; NTIS CSCL 20L

Activities directed toward the development of methods of measurement for semiconductor materials, process control, and devices are described. Application of the surface photovoltage technique, a noncontacting method, to the measurement of carrier diffusion length in silicon epitaxial layers and development of a method for measurement of acceleration and terminal angular velocity of a photoresist spinner are outlined. Measurement of resistivity, carrier lifetime, and electrical inhomogeneities in semiconductor crystals; specification of germanium for gamma-ray detectors; evaluation of wire bonds, metallization adhesion, and die attachment; measurement of thermal properties of semiconductor devices, transit-time and related carrier transport properties in junction devices, and electrical properties of microwave devices; and characterization of silicon nuclear radiation detectors are included. Author

N71-33422# Harry Diamond Labs., Washington, D.C.
**ELECTRICAL PROPERTIES OF ZINC- AND TELLURIUM-DOPED SINGLE CRYSTAL GALLIUM PHOSPHIDE**
James D. Penar, Marvin M. Cohen, and Fernand D. Bedard Apr. 1971 27 p refs
(AD-724680; HDL-TR-1484) Avail: NTIS CSCL 20/2

Using the van der Pauw method, Hall and resistivity measurements have been made on Zn- and Te-doped, epitaxially grown, single-crystal GaP. The measurements were made in the temperature range from 4 to 300K in the Zn-doped samples, and from 78 to 300K in the Te-doped samples. Room-temperature carrier concentrations ranged from 7 x 10 to the 15th power to 7 x 10 to the 18th power/cc in Zn-doped GaP and 4 x 10 to the 17th power to 2.7 x 10 to the 18th power/cc in Te-doped GaP. Variations of the ionization energies of Zn and Te with impurity concentration were determined from an analysis of the data. Room-temperature hole mobility in Zn-doped GaP varied from 60 to 100 sq cm/V-sec, and in Te-doped GaP from 11 to 91 sq cm/V-sec. The temperature dependence and magnitude of the mobility for both dopants are in good agreement with the calculated values of mobility due to scattering by acoustical and polar optical phonons at high temperatures, for by the mechanism of charged impurity scattering alone. The resistivity measurements of Zn-doped GaP below 78K show that GaP behaves as impure Ge does in the impurity-band conduction range. Author (GRA)

N71-33569 Clemson Univ., S.C.
**FERMI SURFACE TOPOLOGY CHANGES IN In ALLOYS DEDUCED FROM THE BEHAVIOR OF In ALLOY WHISKERS UNDER STRAIN**
Danny Ray Overcash 1969 53 p
Avail: Univ. Microfilms Order No. 70-17450

The effect of elastic stress (sigma) to 0.3 K bar on the resistivity (rho) at room and helium temperatures and on the superconducting transition temperature (T sub c) of In and dilute In alloy whiskers has been measured. These whiskers have diameters of about 1 millimicrom and axes parallel to a closest packed or <101> direction. Alloy contents ranged up to 0.1 at.% Ag, 1.5 at.% Sn, and 3 at.% Cd. The delta T sub c/delta sigma is 51 + or − 7 mK/k bar, in disagreement with results obtained by measuring the change in length of In crystals as they pass through the superconducting transition. The addition of Ag and Sn did not change from the pure In result, but the addition of Cd had a large effect. The initial slope of the T sub c vs. strain curve decreased with increasing Cd content until at 0.9 at.% it was one fourth of its value for pure In. Dissert. Abstr.

N71-33807 Montana State Univ., Missoula.
**PHOTOEMISSION AND OPTICAL INVESTIGATION OF THE ELECTRONIC STRUCTURE OF MOLYBDENUM AND RUTHENIUM**
Kenneth Albert Kress (Ph.D. Thesis) 1970 152 p
Avail: Univ. Microfilms Order No. 70-14698

The photoemission and optical properties of vapor deposited films of molybdenum and ruthenium were measured at room temperature. The photoemission properties measured were in the spectral range of the threshold (4.3 eV and 5.4 eV for Mo and Ru respectively) to 11.8 eV. The optical properties were measured from 0.5 to 11.8 eV. The data from both Mo and Ru were found to be consistent with, and analyzed by, the nondirect transition model. Corrections for the escaping scattered electrons were included in the optical density of states (ODS) analysis. The ODS for E > E sub F was determined by direct numerical inversion of the nondirect model expression for the dielectric constant. The ODS of Mo and Ru was compared with the band calculations of Matthesis for tungsten and rhenium. The relation of the measured ODS's to the explanations based on the electronic density of states for the anamalous isotopic mass dependence of the superconducting transition temperature was discussed. Dissert. Abstr.

N71-33821# Kanner (Leo) Associates, Redwood City, Calif.
Los Alamos Scientific Lab., N.Mex.
**PREPARATION AND SUPERCONDUCTIVITY OF CeRu2 AND ITS Gd, Mn, Fe, Co, AND Ni CONTAINING MIXED PHASES**
M. Wilhelm et al [1970] 14 p refs Transl. into ENGLISH from Phys. Chem. Solids, v. 31, 1970 p 559–565 Prepared for Los Alamos Scientific Lab.
(LA-TR-71-26) Avail: NTIS

Single phase samples of CeRu2 and homogeneous mixed crystals of the formula Ce(1-x)Gd(x)Ru2 and CeRu(2-x)Me(x) (Me = Mn, Fe, Co, Ni) were prepared by means of an appropriate annealing process. Pure CeRu2 becomes superconducting at Tc = 6.2 K. In mixed crystals Ce(1-x)Gd(x)Ru2, Tc decreases proportional to the fourth power of the GdRu2 concentration. Superconductivity extends up to the amount of about 13 mol. % GdRu2, alloys exceeding this concentration are ferromagnetic. When adding CeMe2 a linear depression of Tc was observed. The gradient of this depression is about one order of magnitude greater with Me = Fe or Mn than with Me = Co or Ni. Small amounts of iron present in the available cerium metal were removed by zone melting. Author (NSA)

N71-33745 Colorado State Univ., Fort Collins.
**TRANSPORT PROPERTIES OF N-Ga-As**
Robert Glenn Hamerly (Ph.D. Thesis) 1969 100 p
Avail: Univ. Microfilms Order No. 70-15176

The transport properties of n-type GaAs are investigated through the measurement of the Seebeck and Hall coefficients and the electrical conductivity from 4 K to 300 K in order to deduce the electron scattering mechanisms. The scattering mechanisms considered are: (1) ionized impurity scattering, (2) polar scattering, and (3) an anomalous space charge mechanism. If the latter mechanism, which was previously postulated to explain lowered mobilities in GaAs is included in the Seebeck coefficient as well as the mobility calculations, the experimental results are consistent with the theory. The results indicate that the space charge scattering mechanism is the dominant scattering mechanism for electrons at room temperature in some samples. Dissert. Abstr.

N71-33756# Alabama Univ., Huntsville. Dept. of Physics.
**HIGH TEMPERATURE METALLIC EQUATIONS OF STATE**
Robert Jordan Naumann (Ph.D. Thesis) 1970 108 p refs
Avail: NTIS

A complete equation of state for metals that describes both the solid and the liquid/dense vapor phase is developed. All empirical constants required can be obtained from elementary thermodynamic data at ambient conditions. Since all thermodynamic functions are derived from the partition function, thermodynamic consistency is guaranteed. Phase transitions between the solid and liquid come about naturally by using the Gibbs energy or the Helmholtz energy to determine the stable phase for a given state. Detailed computations were carried out for aluminum, and the ability of the model to predict the behavior of aluminum at pressures of 5 megabars and temperatures of 20,000 K was demonstrated. An extension to other metals by insertion of their appropriate constants is easily accomplished. The model can be extended to higher temperatures with some additional effort by using a method to obtain the electron contributions for temperatures comparable to the Fermi temperature. The model can also be extended to lower densities, provided that temperatures are low enough to completely neglect electronic contributions. Author

N71-33767 Pennsylvania Univ., Philadelphia.
**RAMAN SCATTERING IN BaTiO3 AND IN OPAQUE SEMICONDUCTORS**
Aron Pinczuk (Ph.D. Thesis) 1969 163 p
Avail: Univ. Microfilms Order No. 70-16198

The optical phonons of tetragonal BaTiO3 and single crystals of InSb were used to study Raman scattering. The spectra were excited with a He-Ne laser operating at 6328 A and were analyzed with a double grating spectrometer. Three scattering geometries were used: backscattering, forward scattering, and right angle scattering. The results obtained on BaTiO3 were used to obtain the frequencies of the optical phonon at the Brillouin zone center. Spectra were also obtained for scattering wave vectors along directions other than the crystal principal axes. Spectra were obtained of the Brillouin zone center LO and TO optical phonons of n-type and p-type InSb. These spectra indicate that within the skin depth of InSb for 6328 A radiation (approximately 300 A), a depletion of first order scattering is found on the LO phonon band which is explained as a surface electric field induced Raman scattering. It was also found that temperature changes can change the relative intensities of the LO and TO phonon bands. Dissert. Abstr.

N71-33772 Clemson Univ., S.C.
**THE EFFECT OF APPLIED STRAIN ON THE ELECTRICAL RESISTANCE AND SUPERCONDUCTING TRANSITION TEMPERATURE OF THIN LEAD FILMS**
Edward Thomas Hutcheson (Ph.D. Thesis) 1969 79 p
Avail: Univ. Microfilms Order No. 70-17447

The normal state resistance and superconducting transition temperature of thin lead films were measured as a function of film thickness and applied strain over a broad thickness range. Thin lead films varying in thickness from <100A to approximately equal to 1000A were vapor deposited at 77K under high vacuum conditions onto mica substrates which had previously been coated with a thin layer of silicon monoxide. Tensile and compressive strain was applied to the films by substrate bending methods and the corresponding changes in electrical resistance and T sub c were observed. All strain effect measurements were performed on the films before and after annealing to room temperature. Tensile strain increased the film resistance and compressive strain decreased the film resistance in qualitative agreement with previous experimental results on bulk lead. The superconducting transition temperature of both annealed and unannealed lead thin films showed a monotonic decrease with increasing residual film resistance. Dissert. Abstr

N71-33804 Florida Univ., Gainesville.
**THERMAL EXPANSION AND ISOTHERMAL COMPRESSIBILITY OF SOLID NITROGEN AND METHANE**
David Craig Heberlein (Ph.D. Thesis) 1969 82 p
Avail: Univ. Microfilms Order No. 70-14883

Relative length changes in solid nitrogen have been measured at zero pressure from 4.2 to 40 K. The observed length changes in alpha nitrogen are found to increase exponentially with temperature from approximately 20 K to the solid transition temperature. This result is compared with a model which attributes this type of behavior to the creation of orientational defects, and the activation energy required to create such defects is calculated. The volume change associated with the first-order transition in solid nitrogen has been measured. The coefficient of linear expansion has been calculated by making a point-by-point differentiation of length changes corresponding to temperature changes. Relative length changes at constant temperature have been measured as a function of pressure. From these data, the isothermal compressibility has been determined from 8 to 40 K. Using the Debye model for solids, the thermal expansion coefficient and the isothermal compressibility measured in this work are combined with available data on the specific heat of solid nitrogen to determine the temperature dependence of the Gruneisen parameter. The thermal properties of solid nitrogen are compared where applicable with similar or related properties measured by other workers. Dissert. Abstr.

N71-33845# National Science Foundation, Washington, D.C. Special Foreign Currency Science Information Program.
**THEORETICAL STUDY OF F2(PLUS) COLOR CENTER FORMATION IN ALKALI HALIDE CRYSTALS [TEORETICHESKOE RASSMOTRENIE F(2) (PLUS) TSENTRA OKRASKI V SCHELOCHNO-GALOIDNYKH KRISTALLAKH]**
A. A. Berezin 1970 12 p refs Transl. into ENGLISH from Zh. Fiz. Khim. (Moscow), v. 42, no. 4, 1968 p 47-51
(TT-70-57054; DMDC-6626) Avail: NTIS

If KCl crystals containing F-color centers are irradiated in the near ultraviolet region, M-absorption band with maximum at 800 microns gets attenuated while a new band with maximum at 1400 microns appears in the long-wave region. The reverse process of attenuation of the new absorption band and restoration of M-band is stimulated on irradiating the crystal in F-band. It is natural to assume that in the case of ultraviolet irradiation, a part of M-centers ionizes, forming F2(+) centers. Decrease in the number of M-centers leads to attenuation of M-absorption while energy transition in the newly formed F2(+) centers leads to the appearance of a new band in the absorption spectrum. In the reverse process, irradiation in F-band excites a part of F-centers. By thermal ionization, the excited F-center supplies an electron to the conductivity zone which easily recombines with the F2(+) center. Author (GRA)

N71-33848# Toulouse Univ. (France).
**CONTRIBUTION TO THE STUDY OF CORRELATIONS BETWEEN FUNCTIONAL CONDITIONS AND ELECTRICAL PROPERTIES OF METAL OXIDE SEMICONDUCTOR STRUCTURES [CONTRIBUTION A L'ETUDE DE LA CORRELATION ENTRE LES CONDITIONS D'ELABORATION ET LES PROPRIETES ELECTRIQUES DES STRUCTURES METAL OXYDE SEMI-CONDUCTEUR (MOS)]**
Roberto Milward-Spolidoro (Ph.D. Thesis) 15 Dec. 1970 153 p refs In FRENCH
(Rept-1-028) Avail: NTIS

Microelectronic performance of a metal oxide semiconductor in relation to its composite structural geometry is considered. A theoretical parametric model is formulated for an aluminum-silica-silicon structure that gives optimal operational characteristics from calculations of physical factors of applied stress with majority carrier depletion, accumulation, and inversion. Transl. by G.G.

N71-33864 Montana State Univ., Bozeman.
**HYDROGEN BONDING IN LITHIUM HYDRAZINIUM SULFATE**
Francis Luther Howell (Ph.D. Thesis) 1970 122 p
Avail: Univ. Microfilms Order No. 70-14696

The nuclear magnetic resonance spectrum of deuterons in LiN2D5SO4 has been studied in detail between 78 and 458 K. The spectrum at 78 deg is related to the deuterons of a static N2D5(+) ion. The electric quadrupole coupling constants, the asymmetry parameters, and the orientations of electric field gradient (efg) tensors relative to the crystal axes were obtained at 78, 193, 298, 338, 368 and 438 K. Above 110 K the lines due to the deuterons of the ND3 group broaden and merge to a single pair of lines which is still evident at 195 C. The lines corresponding to the deuterons of the ND2 group merge to a single pair between 0 and 50 deg C. These line mergers are related to the motion of the ND3 and ND2 groups and estimates of the activation energy and jump times of these motions are made. Because of the symmetry of the crystal, the absence of line doubling indicates that ferroelectric domain reversal may be due to reflection of the structure through the ab plane. Dissert. Abstr.

**N71-33874** University of Southern Calif., Los Angeles.
**ELECTRON BEAM MODULATED OPTICAL PROPERTIES OF SEMICONDUCTORS**
John Henry Mc Coy (Ph.D. Thesis) 1970 148 p
Avail: Univ. Microfilms Order No. 70-16875

The electron beam of an electron probe microanalyzer was periodically gated to modulate the reflectance of a semiconductor, with the reflectance being measured through optical system of the microanalyzer. This optical system was modified by the addition of a special illuminator and a monochromator to analyze the reflected light. Modulated reflectance spectra were measured on GaAs, Ge, Si, and GaP over a range of photon energies from 1 ev to 3.6 ev. Relative reflectance magnitudes up to 0.03 were achieved. Because both heat and excess carrier pairs were generated by the electron beam, there were at least four possible models for the physical modulation mechanism. Experiments were devised to determine which model was most appropriate. Dissert. Abstr.

**N71-33885** Colorado State Univ., Fort Collins.
**THE MOESSBAUER EFFECT IN SEVERAL GROUP 3A-ANTIMONIDES**
Roger Arthur Pruitt (Ph.D. Thesis) 1969 75 p
Avail: Univ. Microfilms Order No. 70-15191

The Mossbauer isomer shift was used to establish the relative ionicity present in the predominantly covalent bonding in the series AlSb, GaSb, and InSb which form a set of compounds having the same structure, symmetry, and anion, Sb. It was found that they can be ordered according to increasing ionicity: InSb, GaSb, AlSb. In addition, the bonding was investigated in ternary phases of Ga(x)In(1-x)Sb for several values of x, and the Mossbauer studies reveal each alloy to be of a single phase with ionicity intermediate between GaSb and InSb according to percent composition. Dissert. Abstr.

**N71-33890#** Cornell Univ., Ithaca, N.Y. Lab. of Atomic and Solid State Physics.
**STUDY OF THE TRANSVERSE MAGNETORESISTANCE OF POLYCRYSTALLINE POTASSIUM**
H. Taub, R. L. Schmidt, B. W. Maxfield, and R. Bowers Feb. 1971 74 p refs Sponsored by AEC
(NYO-2150-68) Avail: NTIS

The impurity, strain, temperature, and size dependence of the transverse magnetoresistance of polycrystalline potassium has been investigated in fields up to 100 kG. The results of both low-field helicon experiments on large rectangular plate samples and 4-terminal measurements on long wires show the existence of a non-linear, low-field behavior or knee previously reported in the magnetoresistance. The shape of the knee is observed to be strongly dependent on sample annealing and purity and, to a lesser extent, on temperature. In all samples under all experimental conditions, there is a linear magnetoresistance at high fields. The well-annealed wires exhibit a regular pattern in the impurity dependence of the high-field Kohler slope which differs from that reported for other simple metals. Author

**N71-33891** Illinois Inst. of Tech., Chicago.
**MAGNETIC FIELD EFFECTS ON THE THERMAL CONDUCTIVITY OF CO((NH2)2CS)4-CL2**
Chen-chou Ni 1970 131 p
Avail: Univ. Microfilms Order No. 70-14933

Thermal conductivity measurements have been made on a single crystal of Co((NH2)2CS)4-Cl 2 in the temperature range 0.35 – 20 K and in applied magnetic fields of up to 22 kG. By means of the low temperature thermal conductivity measurements, the following distinctive phenomena were observed and interpreted according to existing theories: First, the phenomenon of antiferromagnetic spin wave thermal energy transport was observed below the Neel temperature. Second, the temperature and applied magnetic field dependence of thermal conductivity above the Neel temperature shows that the ground state of the magnetic ion Co(++) is a Kramers doublet. This conclusion is in agreement with specific heat measurements. Third, anomalies expected according to the theoretical predictions for spin wave energy density fluctuations in the region of a magnetic phase transition were observed. Dissert. Abstr.

**N71-33898** Florida Univ., Gainesville.
**LOW TEMPERATURE ANISOTROPIC THERMAL CONDUCTIVITY OF CADMIUM SELENIDE**
Paul Lee Jacobs (Ph.D. Thesis) 1969 102 p
Avail: Univ. Microfilms Order No. 70-14888

The thermal conductivity of cadmium selenide single crystals has been measured from 6 to 100 K. Both undoped and high resistivity (selenium compensated) samples were tested, with measurements made both parallel and perpendicular to the c axis. The experimentation was performed using a doubly guarded unidirectional steady state thermal conductivity apparatus designed for this purpose. The results show that heat-treatment under selenium vapor has no effect on the thermal conductivity in this temperature range. Above 30 K no anisotropic effects were noticed. An attempt was made to fit the data, using the Callaway theory. It was found that the combination of isotope, boundary, and phonon-phonon scattering alone will not account for the observed thermal conductivity. Varying the parameters in the theory would not allow all regions of the thermal conductivity curve to be simultaneously fitted to the data. It is concluded that impurity scattering and electron-phonon scattering, which were not included in the theory, could account for the observed thermal conductivity. Dissert. Abstr.

**N71-33912** California Inst. of Tech., Pasadena.
**FLUX REVERSAL IN FERROMAGNETIC THIN FILMS**
Mark Howard Kryder (Ph.D. Thesis) 1970 245 p
Avail: Univ. Microfilms Order No. 70-14842

Flux reversal in Ni-Fe thin films has been studied with the use of 10 nsec exposure time Kerr magneto-optic photographs which depict the dynamic magnetization configuration with 10 microns resolution during the reversal process. The photographs show that at least five mechanisms are involved in the reversal of thin films: (1) domain wall motion, (2) coherent rotation, (3) diffuse boundary propagation, (4) nucleation and subsequent reversal of partially reversed regions, and (5) noncoherent rotation. The present investigation has been concerned mainly with the latter three mechanisms as they have either been previously unreported or poorly understood. Dissert. Abstr.

**N71-33927** City Univ. of New York.
**INTERACTIONS OF REFRACTORY METAL SILICIDE COATINGS WITH SUBSTRATES**
Leon Joseph Schwartz (Ph.D. Thesis) 1970 277 p
Avail: Univ. Microfilms Order No. 70-15465

The growth rate of Ta5Si3 and the rate of degradation of TaSi2 in the Te/TaSi2 system has been measured. Six metals were tested as barriers to the degradation of TaSi2. They were: tungsten, rhenium, molybdenum, niobium, zirconium and titanium. None of the metals tested was effective in lowering the rate of loss of TaSi2. In all but the Ti/TaSi2 system, Si alone was shown to diffuse. Incompatibility in the W/TaSi2 and Re/TaSi2 systems interrupted solid state diffusion and resulted in the vapor transport of Si, particularly during the early stages of the diffusion anneal. Dissert. Abstr.

**N71-33940** Tufts Univ., Medford, Mass.
**QUANTUM LIMIT TRANSPORT PHENOMENA IN InAs AND InSb AT LOW TEMPERATURES**

Larry Allan Kaufman (Ph.D. Thesis) 1969 151 p
Avail: Univ. Microfilms Order No. 70-17393

The Hall coefficient has been measured in InAs and InSb in the temperature range 4.2K – 0.58 K and in magnetic fields up to 210kG. The binding energy of magnetically induced bound states associated with electrons trapped at impurity sites has been deduced from these measurements in InAs. An additional contribution to the binding energy from spatial fluctuations in the random impurity ion distribution must be included in the theory. Evidence for the presence of this effect was also found in InSb below 1 K. Transverse magnetoresistance measurements in InAs in the temperature range 4.2 K – 1.5 K and in magnetic fields up to 210kG have revealed the important role of scattering by long range ionized impurities. Dissert. Abstr.

**N71-33979#** Oak Ridge National Lab., Tenn.
**PENETRATION OF INDUCTION, ELECTRICAL FIELD, AND LOSSES IN IMPURE TYPE-2 SUPERCONDUCTORS HAVING A SURFACE CURRENT**
G. Fournet et al May 1971 22 p refs Transl. into ENGLISH from J. Phys. (Paris), no. 31, 1970 p 357–367 Sponsored by AEC
(ORNL-tr-2475) Avail: NTIS

The behavior of hard superconductors in ac magnetic fields is studied. The other works on the same subject used the critical-state model, assuming that the bulk critical current density j depends on the magnetic induction B on each point by the way of a mere algebraic relation; here the critical state model is used in the general form where j is any function of B; a critical surface current is also considered. Rigorous expressions of the electric field at each point are given, and a method of measurement of the critical current densities at low magnetic field is deduced. The behavior of hard superconductors for several critical-state laws is then calculated. Experiments, performed especially with Nb–25% Zr, show a good fit with the theoretical results. Finally, the losses are calculated, and the rigorous theoretical relations obtained for some critical laws show that several expressions given by other works are only approximations. Author (NSA)

**N71-33998#** State Inst. for Technical Research, Helsinki (Finland).
**THE dc CONDUCTIVITY MEASUREMENTS ON Se SINGLE CRYSTALS GROWN BY THE TRAVELING SOLVENT METHOD**
R. Mustonen, O. Pilvios, and T. Stubb 1971 11 p refs
(Rept-161) Avail: NTIS

Trigonal selenium single crystals with different thallium concentration rates are grown by the traveling solvent method. The current-voltage characteristics are measured at room temperature and at liquid nitrogen temperature. The measurements show no correlation between the thallium concentration (0.03 to 0.3 atomic percentage) and the current voltage curves. In comparison with single crystals grown from supercooled melt there is, however, a difference of one decade in conductivity at room temperature and a difference of three decades at liquid nitrogen temperature. Author

# 27 PROPELLANTS

Includes fuels; igniters; and oxidizers. For basic research see: 06 Chemistry; and 33 Thermodynamics and Combustion. For related information see also: 28 Propulsion Systems.

**N71-32898*#** Southwest Research Inst., San Antonio, Tex.
**PROPELLANT DYNAMICS IN AN AIRCRAFT-TYPE LAUNCH VEHICLE**
Franklin T. Dodge and Luis R. Garza Jul. 1971 28 p refs
(Contract NAS8-25920)
(NASA-CR-119891; DCN-1-0-75-00087(1F)) Avail: NTIS CSCL 21I

Propellant sloshing in a tilted cylindrical tank is studied experimentally and analytically. Two distinct fundamental modes are shown to exist, one of which can be excited by tank motions parallel to the long axis (long mode) of the elliptical free surface and one by motion perpendicular to it (short mode). Experimental results show that the natural frequencies of both modes decrease as the tilt increases and the slosh damping decreases markedly with increased tilt for the long mode. The shape of the long mode is significantly asymmetrical although the short mode appears similar to the slosh mode in an upright tank. Analytical results confirm these observations, and a mathematically equivalent mechanical model is derived. The model shows that the slosh mass for the long mode decreases as the tilt increases. More importantly, the model indicates that an oscillating force is created parallel to the thrust; this could be important in pogo applications. Author

**N71-33084#** Rocketdyne, McGregor, Tex. Solid Rocket Div.
**THE PHENOMENLOLOGY OF SYNERGISTIC CATALYZED PROPELLANTS Semiannual Technical Report, 1 Nov. 1970–30 Apr. 1971**
G. D. Sammons 27 May 1971 54 p
(Contract N00014-70-C-0354)
(AD-724317; R-4646-1; SATR-2) Avail: NTIS CSCL 7/4

The report covers a continuing study of the Keenan catalyst system. This catalyst consists of a transition metal and a chloride, which was found to be synergistic for the catalysis of ammonium nitrate decomposition. Initial differential scanning calorimeter (DSC) experiments produced some results that contradicted those of Keenan; however, micro DTA experiments tended to confirm his results. Extensive use of the TGA during the reporting period resulted in a clearer understanding of the phenomenology of this catalyst system. The use of the TGA has also afforded an explanation of the difference between DSC and DTA results. Eleven propellant mixes were made, and burning rate data were obtained over a relatively wide pressure range. Only representative thermograms are included. Author (GRA)

**N71-33243*#** Lockheed Missiles and Space Co., Huntsville, Ala. Research and Engineering Center.
**STUDY ON PROPELLANT DYNAMICS DURING DOCKING Interim Report**
G. C. Feng and S. J. Robertson Jun. 1971 73 p refs
(Contract NAS8-25712)
(NASA-CR-119904; HREC-5712-1; LMSC-HREC-D225157) Avail: NTIS CSCL 21I

A modification of the Marker-and-Cell (MAC) computing technique was developed to calculate the two-dimensional or axisymmetric flow of liquids in fuel tanks of space vehicles during a docking maneuver in orbit. The basic MAC technique was modified to include the capability for treating flows with arbitrary curved boundaries and surface tension effects. In addition the capability was included for computing forces and moments on the tank walls caused by the propellant motion in the tank. The modified computer program was utilized to calculate the propellant dynamics in two-dimensional and axisymmetric tanks for several specific cases. Some numerical instabilities developed on the free surface for low viscosity fluids. Other numerical problems appeared in regions of thin liquid layers, such as a trailing tail of liquid moving along the tank boundary. These instabilities appear only in regions near the surface and are apparently unrelated to the numerical stability criteria which apply to all computational cells. The preliminary investigation has indicated the probability of a high degree of success in modifying the MAC technique for use in three-dimensional flow conditions. Author

N71-33620*# Jet Propulsion Lab., Calif. Inst. of Tech., Calif. Propulsion Div.
**SOLVENT-STRESS-CRACKING AND FATIGUE PROPERTIES OF LIQUID-PROPELLANT EXPULSION TEFLON BLADDERS**
Edward F. Cuddihy 1 Aug. 1971 34 p refs
(Contract NAS7-100)
(NASA-CR-121474; JPL-TR-32-1535) Avail: NTIS

A study of the effects of solvent on the biaxial properties of standard laminate materials demonstrated that standard laminate is sensitive to solvent and fails from solvent stress-cracking at strains less than 6% when biaxially stressed. A correlation between fatigue and stress-strain behavior of Teflon materials was observed which, together with knowledge of the ultimate breaking stress of the materials, can be used to obtain an estimate of the fatigue properties and permits a rapid assessment of the expected fatigue behavior of candidate materials for bladders from only a comparison of their ultimate breaking stress. The general principles of this method of fatigue analysis are discussed, emphasis being given to the implication that this technique should have general application for other polymeric materials where stress-strain behavior is comparable to Teflon. Author

N71-33856*# Rocketdyne, Canoga Park, Calif.
**HNF PROPELLANTS Patent Application**
Vernon E. Haury, inventor (to NASA) 10 p Filed 23 Sep. 1970
(Contract NAS7-661)
(NASA-Case-NPO-12015; US-Patent-Appl-SN-74862) Avail: NTIS CSCL 21I

A solid propellant composition containing hydrazinium nitroformate as an oxidizer and utilizing a staturated polymeric hydrocarbon binder and a polyisocyanate as a curing agent to prevent deterioration of the propellant is described. NASA

# 28 PROPULSION SYSTEMS

**Includes air breathing, electric, liquid, solid, and magneto-hydrodynamic propulsion. For nuclear propulsion see: 22 Nuclear Engineering. For basic research see: 23 Physics, General; and 33 Thermodynamics and Combustion. For applications see: 31 Space Vehicles. For related information see also: 27 Propellants.**

N71-32804# Rocketdyne, Canoga Park, Calif.
**APPLICATION OF A RESONANT COMBUSTOR TO ARMY AIRCRAFT ENGINE STARTING Final Technical Report, 1 Sep. 1969 – 30 Sep. 1970**
R. L. Binsley Feb. 1971 89 p refs
(Contract DAAJ02-70-C-0001)
(AD-724125; USAAVLABS-TR-71-3) Avail: NTIS CSCL 21/5

The report describes the results of a 13-month study of the feasibility of starting Army aircraft by means of starting systems utilizing a resonant combustor as the basic power source. Starting of both main engines and auxiliary power units (APU) was considered. Alternative starting techniques were assessed and compared with present techniques. The engine and APU starting starting techniques that best utilize the unique advantages of the resonant combustor were prepared to allow assessment of the characteristics and application problems of these systems. Author (GRA)

N71-32955# Army Missile Command, Redstone Arsenal, Ala. Propulsion Directorate.
**PROTOTYPE DESIGN AND EVALUATION FOR INFRARED NONDESTRUCTIVE INSPECTION OF INSULATED ROCKET MOTOR CASES Final Report**
D. R. Breitzler, C. R. Moore, and L. B. Thorn Mar. 1971 33 p refs
(AD-723964; RK-TR-71-9) Avail: NTIS CSCL 14/2

A direct method, using infrared (IR) techniques, of nondestructively examining an insulated rocket motor in order to predict potential failure by burnthrough has been demonstrated, and a prototype instrumentation system has been developed. The instrumentation system mechanically scans the empty motor case being examined, in an uncontrolled environment, and presents the data in a time independent intensity modulated x-y plot or thermogram. Author (GRA)

N71-32991# ARO, Inc., Arnold Air Force Station, Tenn.
**ANALYTICAL MODEL OF AN EXHAUST GAS COOLING SYSTEM EMPLOYING LIQUID INJECTION Final Report**
J. M. Pelton and C. E. Willbanks AEDC Jun. 1971 57 p refs
(Contract F40600-71-C-0002)
(AD-724687; AEDC-TR-71-60) Avail: NTIS CSCL 13/1

An analysis was undertaken to better understand the phenomena occurring in spray coolers and to develop a mathematical model for comparison with experimental data from an operating unit. The physical characteristics of an operational exhaust gas spray cooler and the instrumentation systems are described. A mathematical model of a spray cooler was developed by assuming kinetic and thermodynamic equilibrium and one-dimensional flow. A mathematical model of a hypothetical, optimum cooler is included in order to have a basis for defining cooler efficiency. The equations were programmed for numerical solution on a digital computer, and several trial case runs are presented. Experimental measurements are compared with the efficiencies predicted by the mathematical models. Author (GRA)

N71-33147# Rocket Propulsion Establishment, Westcott (England).
**COLD FLOW MEASUREMENTS IN THE STUDY OF INJECTION PHENOMENA IN VORTEX-TYPE ROCKET ENGINE INJECTORS**
P. E. Jackman Aug. 1970 42 p refs
(RPE-TR-70/6) Avail: NTIS

Quantitative studies have been made of the flow of water from an isolated sector of a vortex-type injector. The results are used to explain the phenomena observed on tests made during the development of a packaged propellent rocket engine. A correlation is developed to determine the deflection of the tangentially introduced liquid by a jet injected radially, and this result is shown to be applicable to the design of an injector for the hypergolic propellents composed of mixed amine fuel and inhibited red fuming nitric acid. Author (ESRO)

N71-33246*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
**OPTIMIZATION OF ENGINES FOR COMMERCIAL AIR TRANSPORTS DESIGNED FOR CRUISE SPEEDS RANGING FROM MACH 0.90 TO MACH 0.98**
John B. Whitlow, Jr. and Gerald A. Kraft Aug. 1971 71 p refs
(NASA-TM-X-67906; E-6515) Avail: NTIS CSCL 21E

A parametric study was made of a group of separate-flow-exhaust turbofan engines for advanced technology airplanes designed to carry 300 passengers over a transcontinental range. Cruise lift-drag ratios compatible with the supercritical wing were assumed. Combined jet and fan machinery perceived noise was calculated at both the sideline (lift-off) and approach measuring stations. Noise goals as low as 106 PNdB could be met with 20 PNdB of acoustic treatment with a two stage fan having a pressure ratio of 2.25 at cruise. With this amount of suppression, a noise goal about 10 PNdB lower could be met with a single stage fan having a pressure ratio of 1.70. The airplane figure of merit (range

or gross weight) was compromised by the reduction in fan pressure ratio, however. Although these parameters were optimized by reducing cruise speed to about Mach 0.90, direct operating cost was minimized by designing for cruise at Mach 0.94. Noise goals as low as 96 PNdB can probably be met at what looks to be only a moderate economic penalty. Author

N71-33300*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
**A SURVEY OF KAUFMAN THRUSTER CATHODES**
Albert J. Weigand and Shigeo Nakanishi 1971 14 p refs Proposed for presentation at the Symp. on Ion Sources and Formation of Ion Beams, Upton, New York, 19–21 Oct. 1971
(NASA-TM-X-67918) Avail: NTIS CSCL 21C

A survey is presented of various cathodes which have been developed and used in the Kaufman ion thruster. The electron-bombardment type ion source used in the thruster is briefly described. The general design, operating characteristics, and power requirements are shown for each type of cathode from the refractory metals to the plasma diacharge hollow cathodes of today. A detailed discussion of the hollow cathode is given describing starting and cyclic operating characteristics as well as more fundamental design parameters. Tests to date show that the plasma hollow cathode is an efficient electron source with demonstrated durability over 10,000 hours. Author

N71-33317*# National Aeronautics and Space Administration, Lewis Research Center, Cleveland, Ohio.
**KAUFMAN THRUSTER DEVELOPMENT AT LEWIS RESEARCH CENTER**
William R. Kerslake and Paul D. Reader 1971 12 p refs Proposed for presentation at Symp. on Ion Sources and Formation of Ion Beams, Upton, N.Y., 19–21 Oct. 1971
(NASA-TM-X-67915; E-6539) Avail: NTIS CSCL 21C

The current status of research programs on mercury electron-bombardment thrusters was reviewed. Future thruster requirements predicted from mission analysis was briefly discussed to establish the relationship with present programs. Thrusters ranging in size from 5 to 150 cm diameter were described. These thrusters have possible near to far term applications extending from station keeping to primary propulsion. Beam currents range from 10 mA to 25 A at accelerating potentials of 500 to 5000 V. Author

N71-33396*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
**DESIGN AND DEVELOPMENT OF A MICROPOUND EXTENDED RANGE THRUST STAND (MERTS)**
Kenneth W. Stark, Thomas Dennis, Daniel McHugh, and Thomas Williams Washington Aug. 1971 46 p refs
(NASA-TN-D-7029; G-1010) Avail: NTIS CSCL 21H

The Micropound Extended Range Thrust Stand (MERTS) was developed for use in thruster evaluation testing. The design phase of all major subsystems, system diagnostic evaluations, and resulting modifications of the MERTS system are described in detail. The completed MERTS system was tested with a cesium ion engine as a calibration standard. Thrust levels ranging from 24.5 micronewtons to 53.4 micronewtons were measured with a maximum thrust stand error of 4.5 percent. Author

N71-33484*# Camin Labs., Inc., Brooklyn, N.Y.
**ELECTROFORMED INJECTOR FABRICATION TECHNIQUES**
Final Report, 1 Dec. 1969–28 Feb. 1971
S. Hammer and Z. Cacha 31 Jan. 1971 89 p refs Prepared for JPL
(Contract NAS7-691)
(NASA-CR-121434) Avail: NTIS CSCL 21H

A program was conducted to continue the investigation and development of the electroforming technique as a fully competitive and advantageous method of fabricating complex rocket motor injectors for high energy space storable liquid propellants. A previous effort had developed the techniques for fabrication of most of the basic elements, or building blocks of contemporary space storable injectors. The results of the previous program were used to modify the design of a JPL OF2/B2H6 1000 lbf thrust injector which was fabricated and delivered to JPL. The evaluation is included of utilizing the electroforming process for impinging jet doublet elements with orifice diameters in the nominal range of .003 inches and fabrication of injector baffles containing internal cooling passages. In addition, the feasibility of electroforming identical segments of a full injector face from a single master plate that represents only a portion of the entire injector was investigated. The use of electroforming as a mechanism for joining the segments was also evaluated. Author

N71-33549# National Aerospace Lab., Tokyo (Japan).
**A TWO-DIMENSIONAL CASCADE TEST OF AN AIR-COOLED TURBINE NOZZLE. PART 2: ON THE TEMPERATURE DISTRIBUTIONS OF A CONVECTION-COOLED BLADE AS DETERMINED BY NUMERICAL CALCULATION AND BY ANALOGUE SIMULATION TEST**
Toyoaki Yoshida, Kitao Takahara, Hiroyuki Nouse, Shigeo Inoue, Fujio Mimura et al Jan. 1971 24 p refs In JAPANESE; ENGLISH summary
(NAL-TR-232) Avail: NTIS

A numerical calculation by the finite difference method and an experiment by an analogue simulation test by means of an electric resistance paper on the convection-cooled blade temperature are described. These trials are intended to be compared with the measured values by the cascade test that have been shown in Part I of the present pair of Technical Reports. Both of those methods need heat transfer coefficient- and cooling air temperature-distributions and other data as boundary conditions, therefore the results depend on the estimation of these boundary conditions. The calculated values subject to some dependence upon boundary conditions are in fair agreement with the cascade test data. On the other, hand the blade temperature distribution at cross sectional area normal to the spanwise direction and the effect of blade thickness on these temperature distributions by the analogue simulation test are shown and then discussed. According to these results, heat flow near the leading edge region is almost normal to the direction of the blade surface but from halfway to the trailing edge region, the heat flow is almost parallel to the blade surface direction. Author

N71-33582*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
**THEORETICAL ANALYSIS OF A GRID-TRANSLATION BEAM DEFLECTION SYSTEM FOR A 30-cm DIAMETER KAUFMAN THRUSTER**
Walter C. Lathem and Wallace B. Adam (Air Force Academy, Colo.) Aug. 1971 18 p refs
(NASA-TM-X-67911) Avail: NTIS CSCL 21C

A theoretical analysis has been performed on a grid translation beam deflection scheme for use with a 20 cm diameter Kaufman thruster. An analysis which included variations in beam current and grid spacing was made using a single hole model. The beam deflection angle was found to be relatively invariant with beam current. However, grid translation distance prior to direct ion impingement decreased markedly as beam current increased. Larger deflection angles were obtained for closer grid spacing. Effects caused by dishing the grids convex to the discharge chamber were analyzed. No serious problems were uncovered which would preclude dishing. It has been shown that this scheme can provide at least 10 degrees of beam deflection. Author

N71-33578*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
**TECHNOLOGY FOR LOW COST SOLID ROCKET BOOSTERS**
Carl Cieplucn 1971 18 p refs Presented at the JANNAF Combined Propulsion Meeting, Las Vegas, Nev., 1–4 Nov. 1971
(NASA-TM-X-67912) Avail: NTIS CSCL 21H

A brief review of some of the more significant developments in technology for low cost motors is presented and an estimate of the total cost reduction obtainable by incorporating this new technology package into the design of large solid rocket motors is made. The technology review includes the propellant, case material, insulation, nozzle ablatives and thrust vector control areas. The effect that the new technology would have on motor cost was determined for a typical, expendable 160-inch booster application. Included in this cost analysis was the influence of motor performance variation due to both specific impulse and weight change. For the application considered, it was found that motor costs could be reduced by as much as 30 percent when the new technology was introduced into the design. Although this cost advantage will vary depending on the vehicle application, it is clear that significant cost reductions can be made in most applications. It is concluded that new technology can significantly improve the economic attractiveness of future large solid rocket motors.
Author

N71-33760# Office National D'Etudes et de Recherches Aerospatiales, Paris (France).
**REVIEW OF RECENT FRENCH RESEARCH ON UNSTEADY AERODYNAMICS OF AXIAL FLOW COMPRESSORS AND TURBINES [RECHERCHES FRANCAISES RECENTES SUR L'AERODYNAMIQUE INSTATIONNAIRE DES COMPRESSEURS AXIAUX ET TURBINES]**
Jean Fabri 1971 19 p refs Presented at Symp. sur les Ecoulements Instationnaires, Tridimensionnels et Separes, Atlanta, Ga., 10–11 Jun. 1971
(TP-971) Avail: NTIS

Research on unsteady aerodynamics of axial flow compressors or turbines conducted in several French laboratories is summarized. Investigations into the passing blade problem and stage interaction, unsteady flow due to compressor stall, and blade vibration and aerodynamic damping are included along with pertinent results.
Author

N71-33779*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
**EFFECT OF STATOR-ROTOR AXIAL CLEARANCE ON COLD-AIR PERFORMANCE OF A TURBINE WITH TRANSPIRATION-COOLED STATOR BLADING**
Harold J. Schum, Edward M. Szanca, and Frank P. Behning Aug. 1971 13 p refs
(NASA-TM-X-67914) Avail: NTIS CSCL 21E

A single stage axial flow turbine having transpiration coolant ejection through wire mesh shell stator blades was tested with the stator-rotor axial clearance increased to 1-1/2 inches from its design value of 1/2 inch. Results of the two turbine configurations were compared over a range of coolant fractions from 0 to 7 percent, and for turbine conditions corresponding to equivalent design speed and work. It was found that turbine performance improved with the larger clearance. This suggests that if transpiration cooled stator blades are to be used, adequate stator-rotor clearance be provided.
Author

N71-33841# Office National d'Etudes et de Recherches Aerospatiales, Paris (France).
**USING THE ONERA/S4MA HYPERSONIC WIND TUNNEL FOR SUPERSONIC COMBUSTION RAMJET TESTS [UTILISATION DE LA SOUFFLERIE HYPERSONIQUE S4MA POUR LES ESSAIS DE COMBUSTION SUPERSONIQUE DE STATOREACTEURS]**
Christian Soulier and Jean Laverre 1971 15 p refs In FRENCH and ENGLISH Presented at 35th Meeting of the Supersonic Tunnel Assoc., Dallas, 8–9 Mar. 1971
(TP-924) Avail: NTIS

The wind tunnel description is limited to that of the heater and of the Mach 6 nozzle, and includes details of modifications and adaptations made for testing a supersonic combustion chamber of a hydrogen burning ramjet. The aerodynamic nozzle is replaced by the combustion chamber to be tested, supplied through a duct in such a way that at the engine inlet section it has the same velocity, temperature and pressure conditions as it would have in a ramjet flying at Mach 6 at 30 km altitude. The engine thrust is measured by a balance. The pressure of the air supplied by the heater was 10 to 15 bars, and its temperature 1750 deg.
Author

N71-33880# Office National d'Etudes et de Recherches Aerospatiales, Paris (France).
**RESEARCH ON ION PROPULSION AT ONERA [RECHERCHES DE L'ONERA SUR LA PROPULSION IONIQUE]**
Emile Le Grives 1971 13 p refs Presented at DGLR Symp. on Elec. Propulsion System, Braunschweig, 22–23 Jun. 1971
(ONERA-TP-974) Avail: NTIS

Research and developments in France on electrostatic thrusters of the cesium-ion contact type suitable for station keeping and attitude control of synchronous satellites are summarized. A survey is presented of the work performed by O.N.E.R.A. as a technical and scientific adviser for C.N.E.S. on the development of physical measurements and testing procedures for microthrusters. Elaboration of structural elements, passive and active control procedures for testing ionizers, neutral fraction measurements, and ion optics computation methods are included. The development of a test rig for simulation of attitude control by means of electric thrusters is also reported.
Author

# 29 SPACE RADIATION

**Includes cosmic radiation; solar flares; solar radiation; and Van Allen radiation belts. For related information see also: 13 Geophysics; and 24 Physics, Atomic, Molecular, and Nuclear.**

N71-32998# Osservatorio Astrofisico di Arcetri, Florence (Italy).
**SOLAR RADIO EMISSION. OUTSTANDING EVENTS AT 9285 AND 1420 MHz, JANUARY TO DECEMBER 1968**
P. Arena and G. Tofani Florence Univ. 1970 66 p *Its* Osservazioni e Mem. Fascicolo 93
Avail: NTIS

The solar radio emission events recorded at the Observatory of Arcetri during 1968 at the frequencies of 9285 and 1420 MHz with two superheterodyne Dicke modulation radiometers mounted on two parabolic reflectors of 1.5 and 5 m diameter are quoted in the tabular form. The receiver bandwidths are 8 MHz at 9285 Mz and 4 MHz at 1420 MHz; the time constants are 4 seconds for the 9285 MHz receiver and 8 seconds for the 1420 MHz one. The start of every event, when the flux leaves the constant level of at least one unity of solar flux is determined with an uncertainty of 20 seconds for the bursts of impulsive type and with a maximum of 2 minutes for the events characterized by slow rise. The intensity of the events is measured from the preburst level to the maximum reached by the event itself, in solar flux unity, without any correction to the change of the distance sun-earth and this intensity is listed in the tables with Delta phi. The average error of the burst intensity has been considered to be about 12%.
Author (ESRO)

N71-33014# Osservatorio Astrofisico di Arcetri, Florence (Italy).
**X-RAY FLUXES FROM THE SOLRAD 9 SATELLITE (1968-17 A) FROM JANUARY 1969 TO OCTOBER 1969**
M. Landini, B. C. Fossi, G. Poletto, D. Russo, and G. L. Tagliaferri Florence Univ. 1970 31 p refs Sponsored by Ital. Comm. on Space Res. /ts Osservazioni e Mem. Fascicolo 94
Avail: NTIS

X-ray data from Solrad satellites were telemetered at Arcetri since 1964. The Solrad satellites are devoted to monitoring the solar activity in the X-ray and UV regions by means of GM counters and ion chamber. Tables of data concerning 44 – 60, 1 – 20, 1 – 8, and 0.5 – 3 A bands of the Solrad 9 satellite are presented. Between January and October 1969 some 600 passes were recorded lasting, on the average, 8 minutes. Because of some necessary improvements to the equipment at the beginning of November, the telemetry was temporarily interrupted. On average, three passes per day were recorded, i.e. about half an hour per day of observation. ESRO

N71-33049# Finnish Meteorological Office, Helsinki.
**MEASUREMENTS OF RADIATION AND BRIGHT SUNSHINE, 1967 – 1968 [SATEILY-JA AURINGONPAISTEHAVAINNOT 1967 – 1968]**
1971 88 p In FINNISH and ENGLISH /ts Meteorol. Yearbook of Finland Part 4, Vol. 67-68
Avail: NTIS

The results are presented from observations of radiation and sunshine made at Finnish stations during the years 1967 and 1968. Radiation measurements were made at the following five stations: Helsinki (Ilmala), Pilkkio, Jokioinen, Luonet-jarvi and Sodankyla, whose locations are shown. The geographical coordinates and heights of the stations, the height at which the observing instruments were installed, and the types of observing and recording instruments used are outlined. The position of stations at which sunshine recordings were made; their geographical positions and heights, and the use of a heating apparatus, where fitted, are shown. Author

N71-33158# Osservatorio Astrofisico di Arcetri, Florence (Italy).
**SOLAR RADIO EMISSION: OUTSTANDING EVENTS AT 9285, 2830 AND 1420 MHz, JANUARY TO DECEMBER 1969**
Florence Univ. 1970 42 p /ts Osservazioni e Mem. Fascicolo 98
Avail: NTIS

The events recorded at the Arcetri Observatory during 1969 at 9285, 2830, and 1420 MHz with three superheterodyne Dicke modulation radiometers mounted on two parabolic reflectors, of 1.5 m diameter for 9285 MHz, and of 5 m diameter for 2830 and 1420 MHz are tabulated. The receiver bandwidths are 8 MHz at 9285 MHz, 6 MHz at 2830 MHz, and 4 MHz at 1420 MHz; the time constants are 2 seconds for the 9285 and 2830 MHz receivers, and 4 seconds for the 1420 MHz one. ESRO

N71-33206*# California Univ., Berkeley. Space Sciences Lab.
**SECTOR STRUCTURE OF THE SOLAR MAGNETIC FIELD**
John M. Wilcox 13 Oct. 1970 20 p refs Submitted for publication /ts Ser. 11, Issue 73
(Grant NGL-05-003-230; Contract N00014-69-A-0200-1016; Grant NSF GA-1319; Proj. NR-021-101)
(NASA-CR-121420) Avail: NTIS CSCL 03B

The solar sector structure consists of a boundary in the north – south direction such that on one side of the boundary the large scale weak photospheric magnetic field is predominantly directed out of the sun, and on the other side of the boundary this field is directed into the sun. The region westward of a solar sector boundary tends to be unusually quiet and the region eastward of a solar sector boundary tends to be unusually active. This tendency was discussed in terms of flares, coronal enhancements, plage structure, and geomagnetic response. Author

N71-33485 Minnesota Univ., Minneapolis.
**A MEASUREMENT OF CHARGED PARTICLE SPECTRA IN INTERPLANETARY SPACE, PARTS 1 AND 2**
Jerry Allen Lezniak (Ph.D. Thesis) 1969 273 p
Avail: Univ. Microfilms Order No. 70-15764

A solid state-Cerenkov cosmic ray telescope has been placed into solar orbit aboard the Pioneer 8 spacecraft. Many aspects of the solar and galactic cosmic radiation are being investigated with this telescope over a wide charge and energy range with better resolution than has been obtained previously. A measurement has been made of the differential energy spectra of 3 < or = to Z < or = to 9 nuclei from 250 MeV/nuc to 1500 MeV/nuc and the integral flux above 1500 MeV/nuc in late 1967 and early 1968. This measurement has been made with an effective collection factor of 818 sq meters-steradian-seconds and has enabled the accumulation of approximately 15,000 events. The excellent charge resolution of the experiment, the high statistical accuracy of the data, and the fact that the measurement is made in interstellar space free from atmospheric corrections suggests that the measurement represents a new standard in accuracy. Dissert. Abstr.

N71-33526# National Physical Lab., New Delhi (India). Radio Science Div.
**THE SEASONAL AND SOLAR CYCLE VARIATION OF SOLAR EUV FLUX DEDUCED FROM ELECTRON CONTENT MEASUREMENTS**
Tuhi Ram Tyagi, Sant Prakash, and A. P. Mitra Nov. 1970 17 p refs
RSD-55; SR-55) Avail: NTIS

Integrated electron production rates (Q) around sunrise were estimated during winter and summer seasons as a function of solar activity. Calculations were made using the rate of change of electron content deduced from Faraday fading of satellite Explorer-22 and -27 transmissions recorded at Delhi during the period 1965 – 68, the rising half of the present solar cycle. The production rates were calculated for different values of solar activity using appropriate X-ray flux values, but using minimum solar activity flux values for wavelengths 100 to 1300 A and using appropriate average particle density from CIRA 1965 model. The solar activity dependence of EUV flux was derived from the comparison of experimental and theoretical values of Q. Author

N71-33527# National Physical Lab., New Delhi (India). Radio Science Div.
**SOLAR CYCLE VARIATION OF ELECTRON CONTENT OVER DELHI**
Tuhi Ram Tyagi and K. K. Mittal Dec. 1970 22 p refs
(RSD-56; SR-56) Avail: NTIS

The electron content data obtained from the analysis of the Faraday fading records of the satellite Explorer-22 and -27 were used to study the seasonal and solar cycle variation of diurnal changes in electron content values (I). The value of I sub max during winter increased linearly with solar flux but during summer the linear relationship was valid only up to about 150 units of flux and above this it showed saturation; further the rate of increase was greater in winter than in summer. The value of I sub min also showed linear increase with solar flux both during summer and winter, but the rate of increase was greater in summer than in winter. Seasonal anomaly appeared only during daytime and only for high solar activity. Author

N71-33582*# Aeronautical Research Associates of Princeton, Inc., N.J.
**STUDY OF COSMIC IN THE SOLAR ENVIRONMENT Final Report, 12 Jan. 1968 – 11 Jan. 1971**
G. Sandri and A. Klimas Jan. 1971 156 p refs

(Contract NAS5-11104)
(NASA-CR-121440) Avail: NTIS CSCL 03B

The problem of the transport of cosmic rays is formulated in full generality from first principles. A master equation is deduced which allows for a closed formulation of the transport problem. It is shown that two dimensionless parameters (a measure of particle energy and a measure of field fluctuation strength) characterize the transport regimes and that previous modulation theories are incorrect except for high energies where solar modulation effects are very small. The main outcome of this effort is a new convection-diffusion equation which is valid in the energy region where solar modulation is observed. Author

**N71-33567*#** Minnesota Univ., Minneapolis. School of Physics and Astronomy.
**THE SURFACE TEMPERATURES OF SOLAR SYSTEM OBJECTS BY THERMAL EMISSION: A HOMOGENEOUS MODEL SOLUTION**
George Brinton Burnett, III (M.S. Thesis) Aug. 1971 137 p refs
(Grant NGL-24-005-008)
(NASA-CR-121471; Rept-6) Avail: NTIS CSCL 03B

Diurnal and integral cooling curves are obtained for the Moon (1040), Mercury (570), Mars (170), Vesta, Ceres (300), Io, Europa (1000), Ganymede (600), Callisto (1200), Titan and Triton. A homogeneous model solution of the heat conduction equation is used. By comparison to infrared data the values of Gamma in brackets are found. Lack of agreement for Io and Titan suggest the presence of an atmosphere. The Moon and the Jovian satellites are considered in eclipse. A rock-dust crater model is used to determine the % rock in the craters Aristarchus (2%), Copernicus (2%), and Tycho (8%) by comparison to 12 micron data. Author

**N71-33717*#** National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
**DISCONTINUITIES IN THE INTERPLANETARY MEDIUM AND THEIR RELATION TO THE PROPAGATION AND ACCELERATION OF COSMIC RAYS**
L. F. Burlaga Aug. 1971 35 p refs Presented at the Seminar on Acceleration of Particles Near the Earth, and Intersteller Space, the Galaxy and the Metagalaxy, Leningrad, Jul. 1971 Submitted for publication
(NASA-TM-X-65673; X-692-71-327) Avail: NTIS CSCL 04A

Recent measurements of the electron temperature indicate that magnetic and thermal pressures are equally important in the solar wind. Hydromagnetic theory, rather than hydrodynamics, must be used. MHD theory predicts several types of discontinuities. Tangential and rotational discontinuities are important in cosmic ray scattering theory. Observations show that most discontinuities in the interplanetary magnetic field are tangential. Forward and reverse fast shocks and slow shocks, predicted by hydromagnetic theory, have all been observed. Forward fast shocks can accelerate interplanetary particles, increasing their energy several fold to approximately 1 MeV. Fermi acceleration of particles trapped between the shock and magnetic fluctuations can explain the observations. Author

**N71-33732*#** Michigan Univ., Ann Arbor. High Altitude Engineering Lab.
**RADIATION PROCESSES AND THE DISTRIBUTION OF RADIATIVE SOURCES AND SINKS**
William R. Kuhn May 1971 43 p refs
(Contract NASr-54(03))
(NASA-CR-121469; Rept-036350-2-T) Avail: NTIS CSCL 03B

A review is presented of the present state of knowledge of radiative processes and radiative sources and sinks primarily in the mesosphere and lower thermosphere in the height range of 50 to 100 km. The contributions of the various gases to the radiative problem are discussed as well as uncertainties in the results. The radiative contributions of the more important gases to the region as a whole are compared as well as the non-radiative components. Author

**N71-33887** California Inst. of Tech., Pasadena.
**VELOCITY FIELDS IN MAGNETICALLY DISTURBED REGIONS OF THE H ALPHA CHROMOSPHERE**
Phillip Howard Roberts, Jr. (Ph.D. Thesis) 1970 148 p
Avail: Univ. Microfilms Order No. 70-14849

A cancellation machine has been constructed to automatically produce the cancellation required by the method of Leighton in making Doppler movies. Various adaptations of the machine allow rapid data reduction to the 16 mm print required for cinema viewing. The preliminary data gathered in 1966 and 1967 have been reduced. These data consist mostly of the H alpha Doppler movie pairs, and some Zeeman movie pairs, of sunspot regions. A new calibration technique for inferring Doppler velocities from cancellation densities has been developed. Doppler movies taken in H alpha, .070 mm from the core, show a long lived flow region connecting spots of opposite magnetic polarity in newly developing sunspot regions. The flow regions consist of a series of parallel arched filaments about 2 mm thick by 23 + or - 8 mm long which are found also in the H alpha core superimposed upon bright plage. Dissert. Abstr.

**N71-33902** Maryland Univ., College Park.
**STUDIES OF PROMPT GAMMA RAYS FROM NEUTRON CAPTURE IN SILICON, IRON, ALUMINUM, CALCIUM, GOLD, LEAD AND MIXTURES**
Ahmed Ahmed El Kady (Ph.D. Thesis) 1969 142 p
Avail: Univ. Microfilms Order No. 70-12928

The feasibility of utilizing gamma rays from thermal neutron capture as a nondestructive technique to determine the elemental composition of rocks and minerals was studied. The thermal column of the nuclear reactor was adapted to provide thermal neutrons for irradiating samples to produce the gamma rays for this application of nuclear spectroscopy. A high resolution germanium lithium drifted, Ge(Li), detector, about 40 cc, in conjunction with a 1024 channel analyzer, measured the high energy capture gamma ray spectra from silicon, iron, calcium, aluminum, gold and lead. These spectra provided standards for analytical work. Spectra from mixtures of these elements to simulate geological samples were then measured. Element sensitivity curves were constructed by plotting the amplitude of a gamma ray line characteristic of an element against concentration in the mixture. The Sensitivity Indexes for several naturally occurring elements are tabulated. Dissert. Abstr.

**N71-33929*#** Space Disturbances Lab., Boulder, Colo.
**EXTREME ULTRAVIOLET FLASHES OF SOLAR FLARES OBSERVED VIA SUDDEN FREQUENCY DEVIATIONS**
Richard F. Donnelly Sep. 1970 100 p refs
(NASA Order H-42710-A)
(NASA-CR-121461; ESSA-TR-ERL-169-SDL-14) Avail: NTIS CSCL 03A

The properties of EUV flashes from solar flares measured via a type of ionospheric event, called a sudden frequency deviation (SFD), are presented. These results are based on ten years of observations at Boulder wherein about 2000 SFD events were detected and scaled. The rise time, duration, intensity, and fine time-structure of SFD's are statistically studied and present knowledge of the close association of EUV flashes with hard X-ray bursts, white-light emission and microwave radio bursts is reviewed. The relationship of EUV flashes to small bright impulsive kernels in H alpha and other optical observations of solar flares are presented and the location of these kernels discussed. The intensity of EUV flashes is shown to depend upon the central meridian

distance of the flare location; the intensity decreases at the limb. Several models for the impulsive EUV source region are proposed.
Author

N71-33939# National Physical Lab., New Delhi (India).
**INTERPRETATION OF IONOSPHERIC EFFECTS OF SOLAR FLARES**
A. P. Mitra [1970] 25 p refs Submitted for publication
(Contract ESSA-E-2-68(N))
(RSD-58) Avail: NTIS

The classical methods of recording ionospheric effects due to solar flares are discussed. The methods are: (1) sudden absorption increases observed with HF commercial CW transmissions (SWF) or with riometers (SCNAs), and with pulse absorption techniques, VLF/LF phase and amplitude changes (SPA, SEA, SES); and (3) sudden frequency deviations observed with HF standard frequency transmissions (SFD). An example of some of these effects recorded during the flare of January 30, 1968 is presented. These effects are, however, indirect ones: They arise because of an enhancement in ionization which progressively decreases with height from a factor of 5–10 around 70–80 km to about 50–100% in the E region and about 1–20% in the F region. A rough picture of the different degrees of ionization enhancement at different levels is depicted.
Author

N71-33978# Scientific Group for Space Research, Athens (Greece).
**DATA OF SOLAR-TERRESTRIAL INTEREST**
D. J. Ilias and D. P. Elias, eds. Apr. 1971 23 p
Avail: NTIS

Ionospheric, solar, and satellite-borne optical tracking data are presented for April 1971. Ionospheric absorption measurements, SID short wave fadeouts, and satellite and visual sunspot observations are tabulated.
J.M.

# 30 SPACE SCIENCES

Includes astronomy and astrophysics; cosmology; lunar and planetary flight and exploration; and theoretical analysis of orbit and trajectory. For related information see also: 11 Facilities, Research and Support; and 31 Space Vehicles.

N71-32802# Cornell Univ., Ithaca, N.Y. Center for Radiophysics and Space Research.
**HIGH ALTITUDE INFRARED ROCKET ASTRONOMY Annual Progress Report, 15 Nov. 1969–10 Dec. 1970**
Martin O. Harwit, James R. Houck, Barrie W. Jones, Judith L. Pipher, and Baruch T. Soifer 10 Dec. 1970 15 p refs
(Contract F19628-70-C-0128; ARPA Order 1366)
(AD-724131; AFCRL-71-0088; APR-1) Avail: NTIS CSCL 17/5

The report describes the work completed between 15 November 1969 and 10 December 1970, and is divided into five sections: Detectors for the wavelength range 5 micrometers to 30 micrometers, Detectors for the wavelength range 65 micrometers to 1.5 mm, Performance of telescope system, Integration and vibration testing, and Rocket flight AO-4.004--2 December 1970.
Author (GRA)

N71-32809# Academy of Sciences (USSR), Moscow. Inst. for Space Research.
**GEOMORPHOLOGICAL ANALYSIS OF THE AREA OF MARE IMBRIUM EXPLORED BY AUTOMATIC ROVING VEHICLE LUNOKHOD-1**
K. P. Florensky, A. T. Basilevsky, A. A. Gurshtein, V. V. Zezetsky, R. B. Zesin et al 1971 40 p refs Presented at the 14th COSPAR Meeting, Seattle, 1971
(D-92) Avail: NTIS

The results of lunar surface exploration by Lunokhod-1 show that according to general morphology, the explored region of Mare Imbrium is close to the previously investigated maria regions of the lunar equatorial zone. Rock fragments and craters are described, and the size frequency distribution is calculated.
ESRO

N71-32810# Academy of Sciences (USSR), Moscow. Inst. for Space Research.
**INVESTIGATION OF THE MOON WITH THE LUNOKHOD-1 SPACE VEHICLE**
G. I. Petrov 1971 30 p
(D-90) Avail: NTIS

A general description is given of the Lunakhod-1 lunar roving vehicle including landing module, design, and road performance, power system, onboard scientific instruments and cameras. Particular attention is given to the preliminary results of crater observations.
ESRO

N71-32836 RAND Corp., Santa Monica, Calif.
**TOPICS IN HIGH ENERGY ASTROPHYSICS BASED ON LECTURES BY PETER GOLDREICH AT THE RAND CORPORATION DURING JUNE–JULY 1969**
J. Gilinsky, H. Hubbard, G. Modesitt, and P. Colles (San Fernando State Coll.) Nov. 1970 238 p refs
(P-4494) Copyright. Avail: Issuing Activity

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N71-32837 RAND Corp., Santa Monica, Calif.
**PROPAGATION OF ELECTROMAGNETIC RADIATION IN THE GALAXY**
*In its* Topics on High Energy Astrophys. based on Lectures by Peter Goldreich at the RAND Corp. during Jun.–Jul. 1969 Nov. 1970 p 1–16 refs (See N71-32836 20-30)
Copyright. Avail: Issuing Activity

Since electromagnetic radiation is the source of essentially all of the information concerning the distant regions of the Galaxy,

and in order to properly interpret observations, the effects of intervening matter on the propagation of electromagnetic waves are discussed. Author

**N71-32839** RAND Corp., Santa Monica, Calif.
**QUASI-STELLAR SOURCES**
*In its* Topics in High Energy Astrophys. based on Lectures by Peter Goldreich at the RAND Corp. during Jun.–Jul. 1969 Nov. 1970 p 50–57 refs (See N71-32836 20-30)
Copyright. Avail: Issuing Activity

The history of quasi-stellar objects (QSO) is briefly reviewed. The common characteristics of QSO are: (1) strong ultraviolet excess; (2) no sign of typical stellar absorption spectra; (3) no apparent clustering as in galaxies; (4) some objects contain a very small radio source; (5) some spectra show absorption lines; (6) small, sometimes variable, optical polarization up to about 10% are observed; (7) many QSO's with estimates of more than 1 million such objects of magnitude less than 19; (8) observed element abundances are close to normal; and (9) no conclusive evidence exists for variations in the lines, although the continuum is variable. Also discussed are some of the principal puzzles related to QSO's such as: cause of red shift; mechanism of continuous energy production; source of matter which gives rise to absorption lines ejected from the QSO; and no QSO's with z greater than 2.38. A.L

**N71-32840** RAND Corp., Santa Monica, Calif.
**SYNCHROTRON RADIATION AND INVERSE COMPTON SCATTERING, 1**
*In its* Topics in High Energy Astrophys. based on Lectures by Peter Goldreich at the RAND Corp. during Jun.–Jul. 1969 Nov. 1970 p 58–72 refs (See N71-32836 20-30)
Copyright. Avail: Issuing Activity

The radiation from a non-relativistic electron in a uniform magnetic field (cyclotron radiation) is reviewed. Discussed in detail are: (1) relativistic velocities; (2) angular distribution; (3) total radiated power; (4) spectrum of synchrotron radiation; (5) electron distribution; and (6) inverse Compton scattering. A.L

**N71-32841** RAND Corp., Santa Monica, Calif.
**SYNCHROTRON RADIATION AND INVERSE COMPTON SCATTERING, 2**
*In its* Topics in High Energy Astrophys. based on Lectures by Peter Goldreich at the RAND Corp. during Jun.–Jul. 1969 Nov. 1970 p 73–91 refs (See N71-32836 20-30)
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Several examples of logarithmic plots of observed radio sources are presented. Brief discussions are also given on: synchrotron self-absorption; free-free absorption; cold plasma effect; stimulated emission; and implications for quasi-stellar sources. A.L

**N71-32842** RAND Corp., Santa Monica, Calif.
**COSMOLOGY: INTRODUCTION, NEWTONIAN THEORY AND RELATIVISTIC THEORY**
*In its* Topics in High Energy Astrophys. based on Lectures by Peter Goldreich at the RAND Corp. during Jun.–Jul. 1969 Nov. 1970 p 92–114 refs (See N71-32836 20-30)
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Some basic cosmology ideas and terms are presented to help understand the setting in which astrophysical phenomena occur and are observed. Of even more general interest is the possibility that the distant matter in the universe influences local physics. This is a generalization of Mach's principle which asserts that the local inertial frame of reference is determined by the combined effect of distant astronomical objects. Reviewed are: (1) cosmological principle; (2) cosmic time; (3) Mach's principle; (4) three arrows of time; (5) and Olbers' paradox. Discussed in some detail are Newtonian and relativistic cosmology. A.L

**N71-32843** RAND Corp., Santa Monica, Calif.
**TESTS OF COSMOLOGICAL MODELS WITH LAMBDA EQUALS 0**
*In its* Topics in High Energy Astrophys. based on Lectures by Peter Goldreich at the RAND Corp. during Jun.–Jul. 1969 Nov. 1970 p 115–132 refs (See N71-32836 20-30)
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Tests of cosmological models with Lambda = 0 were conducted. The tests included the following three relations: (1) magnitude-red shift; (2) magnitude-galaxy count; and (3) angular diameter-red shift. Results of the tests are described, along with some preliminary discussions on radiation from distant objects. A.L

**N71-32844** RAND Corp., Santa Monica, Calif.
**EXISTENCE OF HORIZONS IN COSMOLOGY**
*In its* Topics in High Energy Astrophys. based on Lectures by Peter Goldreich at the RAND Corp. during Jun.–Jul. 1969 Nov. 1970 p 133–141 ref (See N71-32836 20-30)
Copyright. Avail: Issuing Activity

There are some interesting properties of cosmological models which depend only on the form of the metric. Since this form is independent of the field equations, its consequences may be discussed independently. A simple two dimensional balloon model, which incorporates all the features needed to discuss horizons is described. Author

**N71-32845** RAND Corp., Santa Monica, Calif.
**UNIVERSAL BLACKBODY RADIATION, 1**
*In its* Topics in High Energy Astrophys. based on Lectures by Peter Goldreich at the RAND Corp. during Jun.–Jul. 1969 Nov. 1970 p 142–152 refs (See N71-32836 20-30)
Copyright. Avail: Issuing Activity

The effects of black body radiation ion excitation in the Universe are discussed. Described are: (1) effects of black body radiation on high energy particles; (2) thermal history of the Universe; (3) effect of expansion on temperature; (4) heat capacity; (5) matter radiation coupling; (6) matter and radiation energy density; and (7) anisotropy. A.L

**N71-32846** RAND Corp., Santa Monica, Calif.
**NUCLEOSYNTHESIS IN THE FIRST 1001 SECONDS**
*In its* Topics in High Energy Astrophys. based on Lectures by Peter Goldreich at the RAND Corp. during Jun.–Jul. 1969 Nov. 1970 p 153–165 refs (See N71-32836 20-30)
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Events taking place during the first 1000 sec in the evolution of a big bang universe were investigated. Discussed specifically are elements that could have been formed during this short time and in what abundances. It was necessary to calculate the rate of change of physical distance between particles due to the expansion and find out how the temperature, various particle densities, etc. depend on the expansion function R(t). General assumptions and initial conditions assumed were: (1) That the universe, whether oscillating or open (forever expanding), passed through a stage of T greater than or approximately 10 to the 11th power deg K (greater than or approximately 7 MeV). In the case of an oscillating universe the temperature must be high enough to break the helium into baryons. (2) At very high temperatures neutrons and protons were in statistical equilibrium. (3) The general relativity field equations with the Robertson–Walker metric give a good description of the dynamics of the universe. Author

**N71-32847** RAND Corp., Santa Monica, Calif.
**GALAXY FORMATION**
*In its* Topics in High Energy Astrophys. based on Lectures by Peter Goldreich at the RAND Corp. during Jun.–Jul. 1969 Nov. 1970

p 166–187 refs (See N71-32836 20-30)
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It is pointed out that Jeans' famous theory of galaxy formation based on gravitational instability in a uniform nonrotating fluid assumes a static, not expanding, universe and consequently its conclusions have very limited applicability. However, it can serve as an introduction to more realistic ones, and may be acceptable as a description for secondary condensations occurring within protogalaxies whose contents do not partake in the expansion of the universe. Other drawbacks to this theory are that it does not take into account the expansion of the universe, and that the time at which galaxies form depends critically on the details of the initial density perturbation and on the condensation onset time. It is shown that these situations can be remedied if the effect of the fireball black body radiation on the evolution of matter leading to galaxy formation is taken into effect. Both optically thick and optically thin systems were considered. Derivations for the equations are given. A.L.

**N71-32848** RAND Corp., Santa Monica, Calif.
**PULSAR ELECTRODYNAMICS: THE GOLDREICH–JULIAN MODEL**
*In its* Topics in High Energy Astrophys. based on Lectures by Peter Goldreich at the RAND Corp. during Jun.–Jul. 1969 Nov. 1970 p 188–212 refs (See N71-32836 20-30)
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The Goldreich–Julian (GJ) model represents a significant development in pulsar theory in that it is the first detailed quantitative study of pulsar electrodynamics. An ultimate goal of the study of pulsar electrodynamics is the nature of pulsar radiation. GJ provides a basis for this goal by presenting estimates of field strengths and charge and current densities in the region surrounding the star. It adopts a particularly simple model of an aligned dipole. Another significant result of GJ for the study of radiation mechanism is its finding that charge particles escape the polar regions and are accelerated almost to the velocity of light. The analysis contains an error and the velocity and radiation rate are incorrect. Also, GJ appears to rely rather heavily on the too-literal interpretation of field line velocity, and many of its fundamental arguments regarding the field topology are insufficient. It is pointed out, however, that despite the presence of a number of errors and ambiguities, the authors of GJ display considerable skill and ingenuity in identifying and attacking the basic problems for this complex subject. A.L.

**N71-32866#** Royal Greenwich Observatory, Herstmonceux (England).
**OPTICAL MONITORING OF RADIO SOURCES. PART 1: THE BRIGHTER QUASARS**
M. V. Penston and R. D. Cannon 1970 27 p refs Prepared jointly with Roy. Obs., Cape Town *Its* Bull. No. 159
Avail: NTIS; Roy. Greenwich Obs., Herstmonceux, Engl.: 8s

First results are given from a program for the systematic optical monitoring of quasars for luminosity variations. A summary is given of all previously known information relating to variability. Details are given of new observations of 24 quasars, generally brighter than m sub pg = 17, covering a period of about two years. A statistical test is used to determine whether observations are consistent with the assumption that each quasar is constant in luminosity. Light curves are presented for the 12 quasars. New probable variables are PHL 658, PHL 1377, 3C 249.1, 3C 263, 3C 351, and 3C 380. The detectability of different types of variation is discussed, and it is concluded that while probably all quasars are variable, there exists a well-defined subset of optically violently variable (OVV) quasars. There is a good correlation of OVV activity with both flatness of radio spectrum and radio variability, but no established correlation with optical properties or red-shift. The proportion of OVV identified quasars is about 20 per cent. The observations suggest that a single source is responsible for the variability. The relationship of OVV quasars to similarly behaving N-galaxies is discussed. Author (ESRO)

**N71-32924#** European Space Operations Center, Darmstadt (West Germany).
**ELLIPSOIDAL GRAVITY COEFFICIENTS OF THE GEOPOTENTIAL**
Hans G. Walter 1971 14 p refs Presented at the AAS/AIAA Astrodyn. Specialists Conf., Ft. Lauderdale, Fla., 17–19 Aug. 1971 (AAS-71-338) Avail: NTIS

On expanding the potential in a series of ellipsoidal harmonics a representation is obtained which is conjecturally more adaptable to celestial bodies of ellipsoidal shape such as the Earth, Jupiter, and Saturn. For the realization of this expansion the ellipsoidal coordinates and the Lame functions are introduced as mathematical expediencies. In the special case of the Earth the relationship between the gravity coefficients in the expansion of the geopotential in ellipsoidal harmonics on the one hand and the corresponding coefficients in the spherical harmonics expansion on the other is investigated. A first insight into the numerical behavior of the ellipsoidal gravity coefficients is deduced from orbits of artificial satellites which are based on an adopted gravity model in spherical harmonics. Author (ESRO)

**N71-32944#** European Space Research Inst., Frascati (Italy).
**MAGNETIC FIELD MERGING IN THE SOLAR WIND?**
Karl Schindler [1971] 14 p refs Submitted for publication
Avail: NTIS

Mechanisms of the merging of magnetic lines of force in the solar wind from the magnetospheric tail neutral sheet are studied. Two types of mechanism are reviewed: steady state, and spontaneous merging, the former involving a steady flow and the latter an instability such as the tearing instability. ESRO

**N71-32964#** Air Force Cambridge Research Labs., Bedford, Mass.
**THE OBJECTIVE CONSTRUCTION OF A SOLAR GEOPHYSICAL DATA BASE**
Richard G. Hendl, Ronald T. Podsiadlo, Donald A. Chisholm (Geomet, Inc.), and Isadore Enger (Geomet, Inc.) 26 Feb. 1971 28 p refs *Its* Air Force Surv. in Geophys. No. 230
(AD-724101; AFCRL-71-0142) Avail: NTIS CSCL 3/2

A comprehensive solar-geophysical data base has been assembled. The data base contains a wide variety of error-corrected measurements that have been spatially and temporally correlated to objectively identify those features associated with the same solar regions. The contents of the data base and the logic used to associate the different features are described. Author (GRA)

**N71-33019*#** Houston Univ., Tex. Dept. of Mechanical Engineering.
**ON THE DETERMINATION OF NEAR BODY ORBITS USING MASS CONCENTRATION MODELS**
James Lewis Raney and Bart Childs Dec. 1970 53 p refs (Grant NGL-44-005-084; Contract N00014-68-A-0151) (NASA-CR-121381; RE-10-70) Avail: NTIS CSCL 22A

The observations of a near-body satellite are used in the determination of certain constants appearing in a mathematical representation of the gravitational field of the central body. The determination method employs a perturbation technique, numerical integration of linear and nonlinear differential equations, least-squares fitting criteria, and matrix inversion to determine estimates for the parameters involved. Several models for the representation of central body gravitational fields are discussed and the numerical techniques for evaluation of the parameters involved are briefly reviewed. The computations performed indicate that the

parameters of such models can be estimated numerically. Some of the problems associated with using the method described herein to solve typical trajectory problems are discussed and some actual results are presented. Author

**N71-33032#** Naval Weapons Lab., Dahlgren, Va.
**LUNAR-SOLAR EFFECTS ON THE 60,000 NAUTICAL MILE SOLRAD-HI SATELLITE**
Robert Mueller Nov. 1971 37 p
(AD-724639; NWL-TR-2571) Avail: NTIS CSCL 22/3

Limitations on launch conditions are found which yield acceptable orbits for high altitude satellites planned for the SOLRAD-HI system. Lunar-solar effects and mission constraints result in the conclusion that for a three satellite system with a three year lifetime, the semimajor axes should lie between 60,000 and 70,000 n.m., the eccentricities less than 0.02, the inclinations between 6.5 and 7.0 degrees, and the longitude of the ascending node between -70 and 90 degrees. If the overlap time can be reduced from 30 minutes, larger inclinations can be allowed, and a longer operational lifetime will result. Author (GRA)

**N71-33067#** European Space Research Organization, Paris (France).
**GAMMA-RAY ASTROPHYSICS**
Nov. 1970 107 p refs Proc. of the ESRO Colloq., Noordwijk, Neth., 1-2 Jun., 1970
(ESRO-SP-58) Avail: NTIS

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**N71-33068#** Nagoya Univ. (Japan).
**THEORETICAL HIGH-ENERGY ASTROPHYSICS AND GAMMA-RAY ASTRONOMY**
Satio Hayakawa *In* ESRO Gamma-Ray Astrophys. Colloq. Nov. 1970 p 3-13 refs (See N71-33333 20-30)
Avail: NTIS

The origin of gamma rays in our galaxy is discussed. A correlation is found between the densities of gamma rays and radio sources and the square of the density of hydrogen atoms. ESRO

**N71-33069#** Wisconsin Univ., Madison.
**EXPERIMENTAL RESULTS OF GAMMA-RAY ASTRONOMY FROM BALLOON AND SATELLITE EXPERIMENTS**
W. L. Kraushaar *In* ESRO Gamma-Ray Astrophys. Colloq. Nov. 1970 p 15-32 refs (See N71-33067 20-30)
Avail: NTIS

A review is presented of the OSO-3 high energy gamma-ray data. The data of four orbits, including counting rate from each of the 15 photomultiplier scintillation counters and various coincidence and sum combinations are shown. Effect of geomagnetic latitude and arrival direction are discussed. ESRO

**N71-33070#** Max-Planck-Institut fur Physik und Astrophysik, Munich (West Germany). Inst. fuer Extraterrestrische Physik.
**OBJECTIVES FOR FUTURE GAMMA-RAY MISSIONS. PART 1: OPEN QUESTIONS RELATING TO OBSERVATIONS OF CELESTIAL GAMMA RAYS**
K. Pinkau *In* ESRO Gamma-Ray Astrophys. Colloq. Nov. 1970 p 33-43 refs (See N71-33067 20-30)
Avail: NTIS

Gamma-ray astronomy using broad-band detectors is discussed. The production of gamma rays by pi sup zero decay process is analyzed considering the energy balance. ESRO

**N71-33071#** Palermo Univ. (Italy). Ist. di Fisica.
**OBJECTIVES OF FUTURE GAMMA-RAY MISSIONS. PART 2: SCOPE FOR BALLOON EXPERIMENTS AND COMPARISON WITH SATELLITES**
Livio Scarsi *In* ESRO Gamma-Ray Astrophys. Colloq. Nov. 1970 p 45-59 refs (See N71-33067 20-30)
Avail: NITS

The scope and possibilities for balloon-borne experiments in gamma-ray astronomy are discussed. The minimum detectable flux from a point source in the presence of background flux is determined. Some ideas on the future of gamma-ray astronomy development are presented. ESRO

**N71-33072#** European Space Research and Technology Center, Noordwijk (Netherlands).
**OBJECTIVES OF FUTURE GAMMA-RAY MISSIONS. PART 3. APPROVED AND PLANNED SATELLITE INVESTIGATIONS**
V. Manno *In* ESRO Gamma-Ray Astrophys. Colloq. Nov. 1970 p 61-68 (See N71-33067 20-30)
Avail: NTIS

Gamma ray experiments to be launched in space in the first half of the 1970s are listed. The SAS-B, ESRO's TD-1, and HEAO-A experiments are described. ESRO

**N71-33073#** Leiden Univ. (Netherlands). Kamerlingh Onnes Lab.
**THE COS-B MISSION. PART 1. THE SCIENTIFIC PROGRAMME AND THE PAYLOAD**
B. N. Swanenburg *In* ESRO Gamma-Ray Astrophys. Colloq. Nov. 1970 p 69-79 (See N71-33067 20-30)
Avail: NTIS

Characteristics of the ESRO COS-B satellite are given. The general mission of the satellite is analyzed and the gamma-ray detector is described and its technical performance discussed. ESRO

**N71-33163*#** Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
**THE DEEP SPACE NETWORK, VOLUME 4 Progress Report, May-Jun. 1971**
15 Aug. 1971 223 p refs
(Contract NAS7-100)
(NASA-CR-121378; JPL-TR-32-1526) Avail: NTIS CSCL 22A

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**N71-33164*#** Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
**DESCRIPTION OF THE DSN**
N. A. Renzetti, E. S. Burke, C. W. Harris, and J. E. Maclay *In its* The Deep Space Network, Vol. 4 15 Aug. 1971 p 1–12 refs (See N71-33163 20-30)
Avail: NTIS CSCL 22A

The objectives, functions, and organization of the Deep Space Network are summarized. The Deep Space Instrumentation Facility, the Ground Communications Facility, and the Space Flight Operations Facility are described. Real time and nonreal time analysis of the telemetry system for short- and long-term performance is illustrated with the results from the real time accumulated data for the solar occultation of Pioneer 9 which were compiled and analyzed during nonreal time periods. Improvements in the display capability and provisions of the monitoring system are outlined. J.M.

**N71-33165*#** Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
**MISSION SUPPORT**
A. J. Siegmeth, P. S. Goodwin, R. P. Laeser, D. J. Mudgway, and K. W. Linnes *In its* The Deep Space Network, Vol. 4 15 Aug. 1971 p 13–48 refs (See N71-33163 20-30)
Avail: NTIS CSCL 22A

The Pioneer F and G spacecraft internal data flow designs are described and interfaces between the spacecraft and the Deep Space Network (DSN) data system are identified. A detailed functional description of the Helios spacecraft radio telemetry subsystem is given as well as a description by network system of the planned Mariner Mars 1971 mission configuration. The DSN support for Viking navigation is reviewed and several very long baseline interferometry observations are summarized. J.M.

**N71-33166*#** Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
**ADVANCED ENGINEERING**
K. H. Rourke, V. J. Ondrasik, A. A. Mottinger, W. A. Lushbaugh, H. Fredricksen et al *In its* The Deep Space Network, Vol. 4 15 Aug. 1971 p 49–115 refs (See N71-33163 20-30)
Avail: NTIS CSCL 22A

The application of differenced Doppler and range tracking data types to zero declination and process noise problems is discussed and the results of an analytical study of the advantages which differenced tracking data may offer for ameliorating the effects of unknown spacecraft acceleration are presented. Station longitude error effects on Doppler plus range and Doppler only orbit determination solutions are examined based on a Viking mission trajectory. Digital equipment is described for obtaining an optimum trigger for an oscilloscope. Three algorithms are given for forming the Ford sequence of length, 2 to the nth power, with a comparison of the storage requirements for each. The weights which can occur in the third-order Reed–Muller codes of lengths 256 and 512 are investigated. Results of Monte Carlo experiments are given which show that efficient quickness of detection is attainable simultaneously for various levels of increase in failure rates. System operating noise temperatures of the S-band cones of the Venus and Mars deep space stations are reported for 1 February through 31 May 1971. J.M.

**N71-33168*#** Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
**OPERATIONS AND FACILITIES**
W. G. Stinnett, C. W. Bergman, A. C. Johnson, D. W. Johnston, and R. L. Chafin *In its* The Deep Space Network, Vol. 4 15 Aug. 1971 p 178–212 refs (See N71-33163 20-30)
Avail: NTIS CSCL 22A

A general description is presented of the operation of the Deep Space Network (DSN) command system from the Space Flight Operations Facility (SFOF) as configured for support of the Mariner Mars 1971 mission. Brief descriptions of functional capabilities are included along with the use of the capabilities by DSN and flight project personnel. The mathematical model for calculation of the expected Deep Space Instrumentation Facility (DSIF) Doppler tracking system phase noise is given and discussed as well as the numerical evaluation of the transient response for a third-order phase-locked system. The DSIF operations activities in preparation for, and up to and including, Mariner MARS 1971 launches H and I are outlined with the telemetry and command processing operational programs. J.M.

**N71-33193#** Army Engineer Nuclear Cratering Group, Livermore, Calif.
**STUDY OF EXPLOSIVES FOR LUNAR APPLICATIONS Final Report**
Richard W. Mattes Feb. 1971 183 p refs
(AD-724646; NCG-TR-25) Avail: NTIS CSCL 19/1

The report describes a preliminary study of the use of chemical high explosives in support of anticipated lunar base activities. The introductory sections present a brief summary of terrestrial chemical high explosives state-of-the-art in the fields of excavation, quarrying, mining, tunneling, shallow-hole drilling and seismic surveying. Explosive excavation is described through discussions of explosive excavation principles, explosives and their properties, methods of charge emplacement and firing, and phenomena and methods of predicting magnitudes of the potentially harmful explosion side effects of ground motion, airblast, and missile (ejecta) throwout. Author (GRA)

**N71-33216#** Specola Vaticana (Vatican City).
**SPECOLA VATICANA: REPORT OF THE ASTRONOMICAL OBSERVATORY Annual Report, 1970**
1970 12 p
Avail: NTIS

The activities and research projects of the Vatican Observatory for the year 1970 are presented. Subjects discussed are: (1) emission stars, (2) intermediate latitude fields, (3) polarization, (4) photoelectric photometry of variable stars, and (5) electronic computer programming. Author

**N71-33233*#** Geological Survey, Washington, D.C.
**PRELIMINARY REPORT ON THE GEOLOGY AND FIELD PETROLOGY AT THE APOLLO 15 LANDING SITE**
G. A. Swann, L. T. Silver, R. L. Sutton, G. G. Schaber, M. H. Hait et al 5 Aug. 1971 80 p refs
(NASA Order T-65253-G)
(NASA-CR-119725; Rept-32) Avail: NTIS CSCL 03B

Photogeologic maps of the Apennine-Hadley region (Carr, Howard, and El-Baz, 1971) show the landing area situated near the sinuous Hadley Rille on ray-mantled Eratosthenian mare material in the Palus Putredinis embayment at the base of the Apennine Mountains. Photogeologic map units in this complex area include massif material, interpreted as structurally uplifted blocks mainly of

pre-Imbrian rocks; Apennine material and hilly material, interpreted as Imbrium basin ejecta locally covering massif material; pre-mare crater material consisting of debris from impacts into massif and Apennine material; mare material which forms the Palus Putredinis plain, low ridges in the plain, and the upper walls of Hadley Rille, and interpreted as basaltic flows; dark mantling material that covers low hills near the mare; Eratosthenian and Copernican crater material; talus deposits in the lower part of Hadley Rille; and a veneer of ray material on mare material over a considerable portion of the area, including the landing site. The maps are included. Author

**N71-33237#** California Inst. of Tech., Pasadena. Owens Valley Radio Observatory.
**A CATALOG OF THE NORTH–SOUTH VISIBILITY FUNCTIONS OF RADIO SOURCES AT 1425 MhZ, VOLUME 1, NO. 5**
Edward B. Fomalont 1971 19 p refs Sponsored in part by NSF
(Contract N00014-67-A-0094-0008)
(AD-724183) Avail: NTIS CSCL 3/2

Observations with a North-South interferometer were made in 1966 using the two 90-foot paraboloids at the Owens Valley Radio Observatory to determine the strip-scan distribution in position angle 0 degrees for a large number of extragalactic radio sources. The frequency of the observations was 1425 MHz. In conjunction with other data taken with an East-West interferometer (Fomalont 1967) and off-transit data taken in 1966 and 1967, two-dimensional structures can be deduced for the sources. These results will be published elsewhere (small-diameter sources, Fomalont and Moffet 1971; large-diameter sources, Fomalont 1971). The list of the North-South visibility functions is given here. Only the large diameter sources (>60 seconds) are included. The visibility functions for the small-diameter sources can be inferred from the North-South diameter or the diameter limit given in Fomalont and Moffet (1971). Author (GRA)

**N71-33292#** Belgian Royal Observatory, Uccle.
**CALCULATED DECLINATIONS AND PROPER MOTIONS OF INTERNATIONAL REFERENCE STARS FOR LATITUDES THAT DIFFER FROM CATALOG MERIDIANS**
P. Melchior and R. Dejaiffe 1969 277 p In FRENCH
Avail: NTIS

An astronomical catalog is presented that contains declination and motion data for international service star latitudes observed during earth rotation. All position observations are reduced by the FK sub 4 system and a least squares solution is proposed for each star. Transl. by G.G.

**N71-33319#** Specola Vaticana (Vatican City).
**TABLES OF THE POLARIZATION PARAMETERS RESULTING FROM THE TRANSIT OF LIGHT THROUGH TWO INFINITELY THIN PLANE POLARIZERS**
F. C. Bertieu and G. V. Coyne 1970 58 p refs *Its* Vol. 1, No. 1
Avail: NTIS

Tables were presented which gave the percentage polarization and orientation of the plane of polarization resulting from the transit of light through two infinitely thin polarizers with arbitrary plane polarizing properties. The tables can be used to determine the polarization properties of one polarizer when those of a second polarizer and the resultant polarization for light which transits both polarizers are known. Author

**N71-33406*#** Techtran Corp., Glen Burnie, Md.
**ANALYSIS OF SOME COMET ORIGIN HYPOTHESES ON THE BASIS OF THE RESULTS OF A NUMERICAL ANALYSIS OF HYPOTHETICAL COMETS [ANALIZ NEKOTORYKH PROISKHOZHDENIYA KOMET NA OSNOVANII REZUL'TATOV CHISLENNOGO ANALIZA GIPOTETICHESKIKH KOMET]**
M. A. Mamedov Washington NASA Aug. 1971 8 p refs Transl. into ENGLISH from Dokl. Akad. Nauk Azerb. SSR (USSR), v. 26, no. 6, 1970 p 15–18
(Contract NASw-2037)
(NASA-TT-F-13788) Avail: NTIS CSCL 03B

Using the Lagrangian theory of comet origin as a basis, computer-generated comets are used to support and modify Vsekhsvyatskiy's theory of comet origin on or near the surface of Jupiter. The motion of more than 2000 hypothetical comets, assumed to be the products of eruptions on the surface of Jupiter, were investigated. The motion equations were solved with the aid of the Runge–Kutta method. It was assumed that Jupiter is the central body, and that the Sun moves around Jupiter along a circle with a radius of 5.21 AU and is the perturbing body. The initial value and direction of the velocity at eruption were changed. Author

**N71-33430*** California Univ., La Jolla. Dept. of Applied Physics.
**THE PROFILE OF A JET STREAM**
Lars Danielsson Stockholm Roy. Inst. of Technol. 1971 24 p refs Sponsored partly by Swed. Council for Atomic Res.
(Grant NGR-05-009-110)
(NASA-CR-121451; TRITA-EPP-71-04) Avail: NTIS

Asteroid streams are defined by using a new definition for the average distance between celestial orbits. So far, only three streams in the Flora family have been studied by this method. It is found that the orbits of the members of these streams are well collimated everywhere along their path in contrast to previously defined streams. ESRO

**N71-33433*#** Arizona Univ., Tucson.
**LUNAR DIFFERENTIAL FLUX SCANS AT 22 MICRONS Final Report**
Wendell W. Mendell (M.S. Thesis–Rice Univ.) and Frank J. Low Jul. 1971 94 p refs
(Grants NGL-03-002-116; NGR-03-002-110)
(NASA-CR-121457) Avail: NTIS CSCL 03B

The nighttime lunar surface has been scanned at a variety of phases both before and after new moon. A differential chopping technique was used which records the flux difference between adjacent resolution elements along a scan. In principle the differential scan can be integrated to provide the flux distribution, but slow drifts in the sensor null level frustrated this procedure. However, some cold limb temperatures have been calculated using the planet Jupiter for calibration. The measurements were made with a resolution element of 27 arc seconds on the 28-inch telescope at the University of Arizona. Scan positions were determined by noting features on the illuminated portion of the moon through a boresighted guide telescope. Positional accuracies are within two resolution elements. The technique is particularly sensitive to the detection of nighttime anomalies, and more than 150 of these have been identified. Prior to new Moon a large scale thermal structure is seen, corresponding to a previously unknown nonlinear cooling property of the lunar highlands. The effect could be due to the large scale roughness of the highlands or to a significant rock population with a mean size on the order of 10 cm. Author

**N71-33525#** Los Alamos Scientific Lab., N.Mex.
**PARTICLE COLLISIONS IN THE OPPOSING MASS FLOW HYPOTHESIS: A FACET OF THE SUPERNOVA FRAGMENTATION MODEL OF SOLAR SYSTEM FORMATION**
Wilbur K. Brown Jan. 1971 9 p ref

(Contract W-7405-eng-36)
(LA-4343-Suppl) Avail: NTIS

An investigation was made into some of the consequences of the opposing mass flow hypothesis within the supernova fragmentation model of solar system formation. The results of simple elastic scattering analysis indicate that, in the particle collisions of the two clashing flows, heavy elements would tend to remain in orbit whereas hydrogen, though still gravitationally bound to the Sun, would be removed from orbit. Author (NSA)

**N71-33559*#** National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
**THERMODYNAMIC AND SHOCK PROPERTIES OF A SIMULATED JOVIAN ENTRY ATMOSPHERE**
Sheldon Heimel Aug. 1971 37 p refs
(NASA-TM-X-67909) Avail: NTIS CSCL 03B

The thermodynamic properties of the equilibrium plasma behind normal shock waves (incident and reflected) in a 0.70 Ne-.25H2-.05He mixture are computed for assigned shock velocities from 5 to 15 km/sec and pressures from 0.05 to 1.0 mm Hg. Equilibrium pressure, temperature, enthalpy, entropy, constant pressure heat capacity, and component mole fractions are tabulated for an initial temperature of 298.15K. The free energy of the mixture is minimized to obtain composition. The Debye-Huckel approximation is used to account for ionization potential lowering and partition function cutoff. Author

**N71-33561*#** Massachusetts Inst. of Tech., Cambridge.
**QUARTERLY REPORT OF THE HAYSTACK OBSERVATORY, 1 JANUARY - 31 MARCH 1971**
15 Apr. 1971 25 p refs Prepared for Northeast Radio Obs. Corp.
(Contract NAS9-7830; Grants NGR-22-174-003; NSF GP-16918; NSF GP-25865)
(NASA-CR-121410) Avail: NTIS CSCL 03A

Radar astronomy observations of quasar 3C279 using VLBI techniques make it appear that components of this object are separating at 10 times the speed of light. This startling result is the subject of considerable speculation as to possible explanations. The topographic contour mapping of the moon using the Haystack-Westford radar interferometer has produced the highest resolution results yet obtained. Analysis of the result so far has emphasized the area around craters Alphonsus, Arzachel and Ptolemaeus, the floors of which are at markedly different levels. Reduction of 5 years of high accuracy Venus ranging data has yielded a good measure of the large scale equatorial topography of that planet. Variations over a height interval of 5 km have been found, which correlate well with the observed gross variation of the 3.8-cm radar cross section. Author

**N71-33565*#** General Electric Co., Hampton, Va.
**EXPERIENCE APPLICABLE TO THE VIKING LANDER FROM A STUDY OF RELATED SPACE FLIGHT PROJECTS**
A. J. Butterfield and J. N. Herz 25 Mar. 1971 36 p refs
(Contract NAS1-9100)
(NASA-CR-111876) Avail: NTIS CSCL 22C

Actual experience contained in recent space programs having features related to the Viking lander was identified. Considered were mission science operation, long life, system complexity, atmosphere entry and RTG operation. The data are intended to provide a baseline to support evaluation and planning for the Viking Lander Project. Four space programs were selected for the study: Lunar Orbiter, Mariner 69, Biosatellite, and Nimbus B. Data from the four programs have been collected and ordered in detail sufficient to define the flight and ground failure/ anomalies, hardware and mission configurations, and test programs. The data have been processed into tables, charts, graphs and analyses in depth sufficient to establish the cause-effect correlations between space program activities and potential flight problems. Author

**N71-33588*#** Scientific Translation Service, Santa Barbara, Calif.
**TERRESTRIAL ORGANISMS SURVIVE IN SIMULATED JUPITER ATMOSPHERE [IRDISCHE ORGANISMEN UEBERLEBEN IN SIMULIERTER JUPITERATMOSPHAERE]**
E. Koch Washington NASA Aug. 1971 9 p refs Transl. into ENGLISH from Sterne und Weltraum (West Germany), v. 10, Mar. 1961 p 72-74
(Contract NASw-2035)
(NASA-TT-F-13905) Avail: NTIS CSCL 03B

It is pointed out that the present reducing atmosphere of the giant planets is very similar to the terrestrial atmosphere at the time of the origin of life on Earth. Bacteria which use methane as a source for carbon are discussed, and the chemical reactions involved are examined. Investigations regarding an adaptation of various microorganisms to a methane-ammonia-hydrogen atmosphere are considered including tests in which plants such as the Euphorbia xylophyloides, Euphorbia hermentiana, and Euphorbia cladestina were kept for two months in such an atmosphere. It was found that many microorganisms in the plants had survived the imposed conditions and had even multiplied. Studies with a one-celled algae and with aquatic plant Elodea are also discussed. Author

**N71-33608*#** Techtran Corp., Glen Burnie, Md.
**AGE OF Rb 87/Sr 87 AND CONTENTS OF K, Rb, Sr, Ba, AND RARE EARTHS IN THE LUNAR SOIL FROM MARE FECUNDITATIS BROUGHT BACK BY THE SOVIET LUNA 16 MISSION [AGE RB 87/SR 87 ET TENEURS EN K, RB, SR, BA ET TERRES RARES DU SOL DE LA MER DE LA FECONDITE (LUNE) RAPPORTE PAR LA MISSION SOVIETIQUE LUNA 16]**
C. J. Allegre et al Washington NASA Aug. 1971 20 p refs Transl. into ENGLISH from Proc. of the French Acad., Jul. 1971
(Contract NASw-2037)
(NASA-TT-F-13945) Avail: NTIS CSCL 03B

The Luna 16 automatic probe brought back from Mare Fecunditatis a carrot of lunar soil from a depth of 33 cm. Within the scope of Franco-Soviet cooperation in the field of space, 1 g of lunar soil collected at a depth of 22 cm was given to the French researchers working in this field. This sample was composed of soil and small rock fragments 1 to 4 mm in diameter. The present article concerns the analyses performed on 17 mg of fine lunar soil with the exclusion of all rock fragments. Author

**N71-33712#** Defence Scientific Information Service, Ottawa (Ontario).
**THE PRIMITIVE TERRESTRIAL ATMOSPHERE AND THE ATMOSPHERES OF VENUS AND MARS [SUR L'ATMOSPHERE PRIMITIVE DU GLOBE ET LES ATMOSPHERES DE VENUS ET DE MARS]**
Alexandre Dauvillier Dec. 1970 5 p refs Transl. into ENGLISH from Comp. Rend. Acad. Sci. (Paris), Ser. D., v. 267, 12 Aug. 1968 p 697-700 In ENGLISH and FRENCH
(Rept-70-444) Avail: NTIS

It was shown how the primitive terrestrial atmosphere and the atmospheres of Venus and Mars were of the same nature and essentially made up of water vapor and carbon dioxide. Data also show how the carbon dioxide has carbonated the terrestrial soil and not the soil of Venus, how the oceans on Venus have remained with their water still in the supercritical state, and how the atmosphere of Mars is periodically renewed. Author

N71-33843# Belgian Royal Observatory, Uccle.
**THE FREQUENCY OF BINARY STARS IN THE SIDEREAL UNIVERSE [LA FREQUENCE DES ETOILES DOUBLES DANS L'UNIVERS SIDERAL]**
J. Dommanget 1970 23 p refs In FRENCH; ENGLISH summary Presented at the Congr. de l'Assoc. Francaise pour l'Avancement des Sci., Lille, France, Jul. 1964 *Its* Commun. Ser. B, No. 56
Avail: NTIS

The frequency of known double stars in the part of the universe surrounding the solar system and extending to some hundred parsecs, has been continuously increasing since the discovery, a few centuries ago, of the first representatives of these stellar objects. A discussion of the different known effects of instrument selection in the various fields of observation (visual, spectroscopic, photographic and photometric) makes a complete survey of the problem possible and leads to the conclusion that today, 54% is an extreme minimum for the true frequency of double stars. Single stars are considered more and more as exceptional objects, whereas double stars appear as the most important and fundamental components of the stellar universe surrounding the solar system. Author

N71-33849 + Museum des 20. Jahrhunderts, Berlin (West Germany).
**THE EPOCH OF THE EXTENDED VISION: MAN IN SPACE [DIE EPOCHE DES UEBERFLIESSENDEN SEHVERMOEGENS: DER MENSCH IM WELTRAUM]**
Oct. 1970 347 p refs In GERMAN Original contains color illustration
Avail: NTIS HC $6.00

The phenomenon of technology oriented toward space is illuminated from philosophical standpoints as well as by technical applications and social aspects. Included is a theory that expresses the probability of millions of galaxies, similar products of evolution as our Milky Way, that include countless solar life sustaining systems. Transl. by G.G.

N71-33875# California Univ., San Diego. Dept. of Chemistry.
**THE DISTRIBUTION AND ORIGIN OF THE ELEMENTS AND THEIR ISOTOPES IN NATURE Final Report, 1962–1970**
Harold C. Urey 1970 18 p refs
(Contract AT(04-3)-34)
(UCSD-34-P-43-X-9) Avail: NTIS

Research topics are briefly summarized in terms of diamonds in meteorites, stable-isotope variations in meteorites, cosmogenic rare gases and cavities in iron meteorites, Kr-81/Kr dating method, trapped xenon and krypton and the classification of chondrites, solar-type xenon, and Gd isotopic analyses. Lists are given of equipment, personnel, and publications. NSA

N71-33936# Yeshiva Univ., New York.
**RESEARCH IN NUCLEAR PHYSICS AND NUCLEOSYNTHESIS Annual Progress Report**
1 Feb. 1971 18 p refs
(Contract AT(30-1)-3962)
(NYO-3962-3) Avail: NTIS

Work on a new liquid drop mass formula, the r-process in supernovae, lithium production in stars, the s-process, chemical evolution of the galaxy, and the late stellar evolution is briefly summarized. NSA

N71-33973 Minnesota Univ., Minneapolis.
**THE COSMIC RAY RECORD IN THE METALLIC PHASE OF CHONDRITES**
Laurence Elwood Nyquist (Ph.D. Thesis) 1969 165 p
Avail: Univ. Microfilms Order No. 70-15780

The concentrations and isotopic compositions of the rare gases He, Ne, and Ar were measured mass spectrometrically in the separated metal phase as well as in bulk samples of fifteen ordinary chondrites. The rare gases in the metal phase were primarily spallogenic in origin, as was shown by comparison of the abundance pattern of these gases to that in the chemically similar ion meteorites (approximately 90% Fe, 10% Ni). In particular the He-4/Ar-38 and He-3/Ne-21 ratios in the metal satisfied the relationship given by the semiempirical spallation model used by Signer and Nier to describe the variation in relative production rates with meteroid size and sample location. An analysis of exposure ages of iron meteorites indicated that the average cosmic radiation intensity has been constant within a factor of 2 to 3 on a time scale of 10 to the 9th power y if an exponential time dependence is assumed. The thermal release of He and Ne from meteoritic Ni-Fe was considered. It was shown that these gases are released nearly simultaneously. Dissert. Abstr.

# 31 SPACE VEHICLES

**Includes launch vehicles; manned space capsules; clustered and multistage rockets; satellites; sounding rockets and probes; and operating problems. For basic research see: 30 Space Sciences. For related information see also: 28 Propulsion Systems; and 32 Structural Mechanics.**

N71-32812*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
**SPACECRAFT CHARGE BUILDUP ANALYSIS**
William S. West, J. V. Gore (RCA Res. Labs., Montreal, Canada), M. A. Kasha (RCA Res. Labs., Montreal, Canada), and Herbert W. Bilsky (RCA Corp., Princeton, N.J.) Washington 1971 40 p refs
(NASA-SP-276) Avail: NTIS CSCL 21C

The feasibility of applying charge buildup on spacecraft surfaces to electric propulsion is discussed. Subjects presented are: (1) charge buildup mechanism, (2) current density from various sources, (3) spacecraft floating potential, and (4) protective measures recommended for charge buildup problem areas. Author

N71-32853# Royal Observatory, Edinburgh (Scotland). Satellite Tracking Section.
**STOPWATCH OBSERVATIONS OF SATELLITES, MARCH 1971**
R. D. Eberst 22 Jun. 1971 22 p
(ROE-STS-112) Avail: NTIS

Stopwatch observations made at stations connected with the satellite tracking section during the month of March 1971 are listed in satellite launch order and in time order for each satellite. Various subtotals are given. Author (ESRO)

N71-32855# Aerospace Research Labs., Wright-Patterson AFB, Ohio.
**OPTIMAL CONTROL OF LIBRATION POINT SPACE STATION Final Report**
Lynn E. Wolaver, Isaac R. Steinberg, and Walter D. Seward Jan. 1971 17 p refs
(AD-724113; ARL-71-0016) Avail: NTIS CSCL 22/1

The report covers the development of a control system which maintains a space station in close proximity to one of the earth-moon libration points. Author (GRA)

N71-32867# Royal Observatory, Edinburgh (Scotland). Satellite Tracking Section.

**STOPWATCH OBSERVATIONS OF SATELLITES, JANUARY 1971**
R. D. Eberst 15 Apr. 1971 23 p
(ROE-STS-110) Avail: NTIS

Stopwatch observations made at stations connected with the section during the month of January 1971 are listed in satellite launch order and in time order for each satellite. Various subtotals are given. Author (ESRO)

**N71-32871#** Aerospace Corp., El Segundo, Calif. Engineering Science Operations.
**CONTROL SYSTEM DESIGN FOR SPIN AXIS ALIGNMENT WITH THE ORBITAL MAJOR AXIS Technical Report, Jul. – Oct. 1970**
Richard M. Terasaki 30 Dec. 1970 40 p refs
(Contract F04701-70-C-0059)
(AD-724609; TR-0059(6472)-5; SAMSO-TR-71-50) Avail: NTIS CSCL 22/2

A control system design is presented for a spinning communications satellite in a highly eccentric, near-polar orbit. The design yields an alignment of the spin axis with the line of apsides and obviates ground commands (except possibly for initial attitude acquisition and orbit determination). A technique is developed for the on-board prediction of the time of apogee passage and autonomous control at apogee for spin axis alignment with the local vertical. Cumulative errors in the apogee epoch predictions due to orbital period errors are avoided in this technique. Author (GRA)

**N71-32876#** National Research Council of Canada, Ottawa (Ontario). Space Research Facilities Branch.
**BLACK BRANT ROCKET AKF-4A-19 LAUNCHED AT CHURCHILL RESEARCH RANGE 7 DECEMBER 1970**
Feb. 1971 24 p refs
(SRFB-050) Avail: NTIS

Engineering aspects of payload preparation and launching of the Black Brant rocket AKF-4A-19 at Churchill Research Range on 7 December, 1970 are discussed. This vehicle was launched at the commencement of evening twilight, carrying experiments to determine photometrically the height profiles for HeI and OH emissions in the airglow, to measure the diffuse X-ray background in the 0.2 to 10 keV energy region, and to investigate any local or discrete source contributions. The rocket and payload performed satisfactorily with good data being obtained. Author

**N71-32938#** General Electric Co., Philadelphia, Pa. Re-entry and Environmental Systems Div.
**EFFECTS OF MASS ADDITIONS ON VISCOUS FLOW PARAMETERS Final Report, Jun. 1970 – Jan. 1971**
A. Martellucci and H. Rie Mar. 1971 122 p refs
(Contract F04701-70-C-0179)
(AD-724188; GE-71SD205; SAMSO-TR-71-60) Avail: NTIS CSCL 16/3

The objective of the effort is to re-evaluate the influential mechanisms of interaction between re-entry body heat shield ablation and aerodynamic parameters, based upon data obtained under the preceding STREET-G contract, other ground test data, with analytic results, and with applicable flight test data. The specific objectives of this research are to improve (1) the empirical correlations which account for mass injection effects on the viscous layer thicknesses, (2) the basic turbulent relations for predicting the viscous properties, and (3) the validity of the Crocco integral for turbulent flows with mass injection. The influence of the improved correlations on the vehicle drag for some typical flight vehicles is also ascertained. Author (GRA)

**N71-33003*#** LTV Aerospace Corp., Dallas, Tex. Missiles and Space Div.
**SCOUT FIRST STAGE FLIGHT CHARACTERISTICS**
S. Yanowitch and R. N. Kneuber 15 Mar. 1966 60 p refs
(Contract NAS1-6020)
(NASA-CR-11945; Rept-23.358) Avail: NTIS CSCL 22C

An investigation was conducted to determine the Scout vehicle aerodynamic and control effectiveness characteristics from flight data. Eleven recent Scout flights were analyzed, and the aerodynamic moment coefficients and jet vane and control tip lift effectiveness were adjusted such that the flight measured control surface deflections, and vehicle trajectory parameters could be accurately simulated. Flight data indicated that reduced subsonic and transonic aerodynamic stability compared with wind tunnel test data of a Scout model with no protuberances, supersonic pitching moment at zero angle of attack increased, and jet vane lift effectiveness decreased. Incorporation of the revised data gives good correlation between simulated and measured control deflections and flight path and heading angles. Author

**N71-33012#** Hawker Siddeley Dynamics, Ltd., Stevenage (England).
**X4 SATELLITE: CURRENT DESIGN FEATURES AND APPLICATION**
R. G. Staniforth 1971 15 p Presented at the Brit. Interplanet. Soc. Symp. on Appl. Satellites, Southampton, Engl., 14–15 Apr. 1971 Sponsored by Min. of Aviation Supply
Avail: NTIS

The X4 is the second satellite of the British national space program which is under the control of the Ministry of Aviation Supply (NAS). In the design use is made of power conditioning and data handling equipment developed for X3. Two complementary designs are described: (1) two experiments in the meteorological field, one of which required an accurate three-axis stabilized platform, and (2) the proving of an attitude control system, of high pointing accuracy, using only a propane gas system to provide control torques. The principal design characteristics, such as orbit, configuration and structure, power subsystem, data handling, telemetry, and command and attitude control, are outlined. Author (ESRO)

**N71-33035#** Picatinny Arsenal, Dover, N.J.
**HEIGHT-OF-BURST SOUND RANGING SYSTEM FOR A SUPERSONIC ROCKET**
John R. Frister Apr. 1971 58 p refs
(AD-724664; PA-TR-4224) Avail: NTIS CSCL 17/1

Documentation in this report was provided by the Instrumentation Division, Technical Services Directorate for a jungle penetration fuze program. The Fuze Research Engineering Division of Picatinny Arsenal requested height-of-burst (HOB) measurements in a jungle environment for an electronic fuze incorporated in a supersonic rocket. A sound-ranging system, successfully developed and fabricated in 1967 by the Technical Services Directorate at Picatinny Arsenal, was utilized with some modifications of acoustic sensors and amplifiers. The accuracy of the HOB data received by this system can optimally be plus or minus 5% based on evaluations at Picatinny Arsenal and Aberdeen Proving Ground. This accuracy depends on precise operator measurements in system setup and data reduction procedures, monitoring meteorological conditions in real time and monitoring sound velocity in real time. The details of a successful approach to HOB of supersonic rockets as determined by these fuze tests are included in this report together with the HOB test data and results. In these tests two electronic timing fuzes were compared in a jungle environment; no discernable difference between their performance was measured. Author (GRA)

**N71-33051*#** National Aeronautics and Space Administration. Manned Spacecraft Center, Houston, Tex.
**PROCEEDINGS OF THE SPACE SHUTTLE INTEGRATED ELECTRONICS CONFERENCE, VOLUME 1**

1971 383 p refs Conf. held at Houston, Tex., 11–13 May 1971
(NASA-TM-X-58063) Avail: NTIS HC $6.00/MF $0.95 CSCL 22B

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7. ENTRY NAVIGATION ANALYSIS B. A. Kriegsman and D. E. Gustafson (Massachusetts Inst. of Tech., Cambridge.) p 143–166 (See N71-33058 20-21)

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10. NAVIGATION FOR SPACE SHUTTLE APPROACH AND LANDING USING AN INERTIAL NAVIGATION SYSTEM AUGMENTED BY VARIOUS DATA SOURCES L. A. McGee, G. L. Smith, D. M. Hegarty, R. R. B. Merrick, T. M. Carson et al S. F. Schmidt (Anal. Mech. Associates, Mountain View, Calif.) (National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.) p 221–256 (See N71-33061 20-21)

11. MULTIPLE INERTIAL MEASURING UNITS (IMU) FOR USE IN THE SPACE SHUTTLE VEHICLE (SSV) H. Brown, B. Doran (National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.), and T. R. Armstrong (Sperry Rand Corp., Phoenix, Ariz.) p 257–268 (See N71-33062 20-21)

12. ASSESSMENT OF FLY BY WIRE TECHNOLOGY FOR SPACE SHUTTLE P. E. Blatt (Air Force Systems Command, Wright-Patterson AFB, Ohio) p 269–302 refs (See N71-33063 20-31)

13. A SURVEY OF SHUTTLE CONTROL PROBELEMS C. R. Stone and T. W. Chase (Honeywell, Inc., St. Paul, Minn.) p 303–345 (See N71-33064 20-31)

14. DESIGN PRINCIPLES FOR A SPACE SHUTTLE DIGITAL AUTOPILOT R. Gran (Grumman Aerospace Corp., Bethpage, N.Y.) p 347–363 refs (See N71-33065 20-31)

15. NASA FLIGHT RESEARCH CENTER FLY BY WIRE FLIGHT TEST PROGRAM S. W. Gee and M. E. Burke (National Aeronautics and Space Administration. Flight Research Center, Edwards, Calif.) p 365–391 (See N71-33066 20-31)

**N71-33052*#** National Aeronautics and Space Administration, Washington, D.C.

**INTRODUCTION**

A. O. Tischler *In its* Proc. of the Space Shuttle Integrated Electron. Conf., Vol. 1 1971 p 1–5 (See N71-33051 20-31)
Avail: NTIS HC $6.00/MF $0.95 CSCL 22B

The introductory remarks presented at the Space Shuttle Integrated Electronics Conference are presented. Subjects discussed are the proposed plans for the development of the space shuttle and the time tables leading to deployment of the completed system. Author

**N71-33053*#** Boeing Co., Seattle, Wash.

**DEVELOPMENT PROGRAM PLANNING FOR SHUTTLE AVIONICS**

D. M. Petrie *In* NASA. Manned Spacecraft Center Proc. of the Space Shuttle Integrated Electron. Conf., Vol. 1 1971 p 9–27 (See N71-33051 20-31)
Avail: NTIS HC $6.00/MF $0.95 CSCL 22B

The development program, management techniques, and special tools that are unique to the integrated avionics concept being advanced by the Space Shuttle are described. Emphasis is placed on the test beds and facilities that are necessary to negotiate the interdisciplinary problem that threatens the success of the integrated design approach. Among the facilities required are an integrated avionics demonstrator, a test bed airplane, a mission control/GSE van, and an iron bird with operating subsystems. These requirements are related to the specialized tools necessary to support discrete technology developments. The calendar phasing and typical costs of these facilities are described. Author

**N71-33054*#** General Electric Co., Utica, N.Y.

**RELIABILITY PLANNING AND MANAGEMENT**

J. D. Selby and S. G. Miller *In* NASA. Manned Spacecraft Center Proc. of the Space Shuttle Integrated Electron. Conf., Vol. 1 1971 p 29–50 (See N71-33051 20-31)
Avail: NTIS HC $6.00/MF $0.95 CSCL 22B

The application of reliability planning and management to the development of an integrated electronics system for the space shuttle is discussed. The reliability planning and management methods relate reliability criteria to program planning options and constraints. The procedure incorporates demonstrated reliability growth rates based on visible evidence of performance, enabling the dimensioning of time, resources, assets, and facilities required to bridge the gap between reliability requirements and practical reality of program execution. Author

**N71-33055*#** Grumman Aerospace Corp., Bethpage, N.Y.

**A REALISTIC APPROACH TO A COST EFFECTIVE DESIGN AND TEST PROGRAM FOR FUTURE SPACECRAFT EQUIPMENT**

Gilbert Friedenreich and Howard Wright *In* NASA. Manned Spacecraft Center Proc. of the Space Shuttle Integrated Electron. Conf., Vol. 1 1971 p 51–70 (See N71-33051 20-31)
Avail: NTIS HC $6.00/MF $0.95 CSCL 22B

The results of an analysis to develop specific cost effective guidelines for the design, test and maintenance of reusable spacecraft hardware are presented. The analysis is based on a study of hardware performance and reliability that is thoroughly documented in the Apollo Lunar Module Program. All phases of equipment testing and utilization are described. Major program expenditures in the past were avoidable and early implementation of an effective program, augumented by a rigorous management discipline, can prevent unnecessary cost in the future. Author

**N71-33056*#** National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.

**SHUTTLE ASCENT GUIDANCE AND CONTROL REQUIREMENTS**

J. C. Blair and J. A. Lovingood *In its* Proc. of the Space Shuttle Integrated Electron. Conf., Vol. 1 1971 p 73–101 (See N71-33051 20-31)
Avail: NTIS HC $6.00/MF $0.95 CSCL 22B

In the combined booster/orbiter ascent configuration, the space shuttle is a launch vehicle which has a number of characteristics unlike previous launch vehicles. These new characteristics necessitate an examination of the shuttle ascent guidance and control philosophy to insure that stringent requirements will be met. Some of these characteristics which may force a departure from conventional launch vehicle guidance and control practice are presented. Selected characteristics are discussed and their impact on ascent guidance and control requirements are summarized. Author

**N71-33057*#** Honeywell, Inc., St. Paul, Minn.
**KEY ISSUES FOR SPACE SHUTTLE ASCENT GUIDANCE**
J. G. Rupert *In* NASA. Manned Spacecraft Center Proc. of the Space Shuttle Integrated Electron. Conf., Vol. 1 1971 p 103-139 (See N71-33051 20-31)
Avail: NTIS HC$6.00/MF$0.95 CSCL 22B

Trajectory analysis results for several spacecraft configurations investigated during the Space Shuttle program are presented. Primary factors influencing trajectory design include ascent fuel, structural weight requirements, booster flyback propellant requirements, and the on-orbit propellant needed for an orbiter abort with an engine failure at staging. Each of these variables depends strongly on the attack angle and throttling policy during the mated ascent. Author

**N71-33059*#** National Aeronautics and Space Administration. Manned Spacecraft Center, Houston, Tex.
**GUIDANCE AND CONTROL CONSIDERATIONS FOR AN UNPOWERED ORBITER FROM ENTRY TO TOUCHDOWN**
David W. Gilbert *In its* Proc. of the Space Shuttle Integrated Electron. Conf., Vol. 1 1971 p 167-194 (See N71-33051 20-31)
Avail: NTIS HC$6.00/MF$0.95 CSCL 22B

The guidance and control requirements for the space shuttle orbiter prior to landing on a selected runway are discussed. In order to make most effective use of the available energy, the relative position update should start as soon as possible after emerging from entry communications blackout. A candidate strategy for the terminal area guidance target and the associated terminal area maneuvering are described. Results of a simulator evaluation of a specific terminal area guidance and control system are presented. Author

**N71-33063*#** Air Force Systems Command, Wright-Patterson AFB, Ohio. Flight Dynamics Lab.
**ASSESSMENT OF FLY BY WIRE TECHNOLOGY FOR SPACE SHUTTLE**
Paul E. Blatt *In* NASA. Manned Spacecraft Center Proc. of the Space Shuttle Integrated Electron. Conf., Vol. 1 1971 p 269-302 refs (See N71-33051 20-31)
Avail: NTIS HC$6.00/MF$0.95 CSCL 22B

Flight control design for the Space Shuttle is discussed. Three vehicle configurations are involved: (1) a mated booster/orbiter combination having c.g. offset and unsymmetrical aerodynamic configurations, (2) an orbital vehicle which must perform both as a spacecraft and as an aeronautical vehicle for entry and landing, and (3) a recoverable booster which is also an aeronautical vehicle. The magnitude of the flight control problem is depicted in which the booster weighs in excess of 3.75 million pounds at lift-off and has a landing weight of 700,000 pounds (Ref. 1). The orbiter weighs approximately 840,000 pounds at lift-off and 270,000 pounds at landing. Control moments must be generated through various blended combinations of aerodynamic control surfaces, reaction controls, and thrust vector controls throughout each phase of the mission. Author

**N71-33064*#** Honeywell, Inc., St. Paul, Minn.
**A SURVEY OF SHUTTLE CONTROL PROBLEMS**
C. R. Stone and T. W. Chase *In* NASA. Manned Spacecraft Center Proc. of the Space Shuttle Integrated Electron. Conf., Vol. 1 1971 p 303-345 (See N71-33051 20-31)
(Contract NAS8-25181)
Avail: NTIS HC$6.00/MF$0.95 CSCL 22B

Control problems for various aspects of the space shuttle mission are presented. Subjects discussed are: (1) launch control, (2) entry control, (3) three engine orbiter injection, (4) orbiter pad abort, (5) inflight abort, (6) abort control, and (7) handling qualities. Author

**N71-33065*#** Grumman Aerospace Corp., Bethpage, N.Y. Research Dept.
**DESIGN PRINCIPLES FOR A SPACE SHUTTLE DIGITAL AUTOPILOT**
Richard Gran *In* NASA. Manned Spacecraft Center Proc. of the Space Shuttle Integrated Electron. Conf., Vol. 1 1971 p 347-363 refs (See N71-33051 20-31)
Avail: NTIS HC$6.00/MF$0.95 CSCL 22B

The design of an autopilot for the space shuttle is discussed. The synthesis of a digital autopilot for the Space Shuttle, in all phases of operation, can proceed in an orderly way of using the fundamental dynamic equations of motion. This approach uses many recent developments in the theory of control system synthesis. In particular, the theories of linear optimal control, optimal linear estimation, and pole matching are used to provide answers to some commonly asked questions. Author

**N71-33066*#** National Aeronautics and Space Administration. Flight Research Center, Edwards, Calif.
**NASA FLIGHT RESEARCH CENTER FLY BY WIRE FLIGHT TEST PROGRAM**
Shu W. Gee and Melvin E. Burke *In its* Proc. of the Space Shuttle Integrated Electron. Conf., Vol. 1 1971 p 365-391 (See N71-33051 20-31)
Avail: NTIS HC$6.00/MF$0.95 CSCL 22B

Equipping the space shuttle vehicle with a digital fly-by-wire flight control system is discussed. The past and present space programs have demonstrated performance and reliability of such a system in a space environment; however, only limited actual flight data in an atmospheric environment are available on which to base confidence in the performance of such a system. A technology development program is underway that should provide information on the performance of digital fly-by-wire systems for aerodynamic control. This program, which utilizes an F-8C aircraft as a flight-test vehicle, is being conducted in two phases. Phase 1 is the development and flight testing of a single-channel digital system with a triple redundant direct electrical backup system. Phase 2 is the development and flight testing of a redundant all digital fly-by-wire system. The mechanical flight control system will be deactivated for this program. Author

**N71-33074#** European Space Research and Technology Center, Noordwijk (Netherlands).
**THE COS-B MISSION. PART 2: PRELIMINARY ORBIT DEFINITION AND ENVISAGED SPACECRAFT CONCEPT**
G. Altmann *In* ESRO Gamma-Ray Astrophys. Colloq. Nov. 1970 p 81-90 (See N71-33067 20-30)
Avail: NTIS

COS-B scientific mission requirements, technical constraints affecting the choice of the orbit, characteristics of orbit, data transmission capability and ground station coverage for the selected orbit are described. Tentative launch dates are listed and the satellite concept given. ESRO

**N71-33112#** Royal Observatory, Edinburgh (Scotland). Satellite Tracking Section.
**STOPWATCH OBSERVATIONS OF SATELLITES, FEBRUARY 1971**

R. D. Eberst 11 Jun. 1971 26 p
(ROE-STS-111) Avail: NTIS

Stopwatch observations made at stations connected with the satellite tracking section during the month of February 1971 are listed in satellite launch order and in time order for each satellite. Various subtotals are given. Author (ESRO)

**N71-33145#** European Space Research and Technology Center, Noordwijk (Netherlands).

**FEASIBILITY STUDY OF A POLAR ORBITING EUROPEAN METEOROLOGICAL OPERATIONAL SATELLITE**

W. Nellessen and E. L. Heacock 1971 28 p Presented at the Brit. Interplanet. Soc. Meeting on Appl. Satellites, Southampton, Engl., 14–15 Apr. 1971
Avail: NTIS

A study of of a quasipolar orbiting satellite with a view to an ongoing operational system for global meteorological observation by day and by night is presented. ESRO

**N71-33159#** Royal Observatory, Edinburgh (Scotland). Satellite Tracking Section.

**STOPWATCH OBSERVATIONS OF SATELLITES, DECEMBER 1970**

R. D. Eberst 26 Feb. 1971 42 p
(ROE-STS-109) Avail: NTIS

Stopwatch observations made at stations connected with the Satellite Tracking Section during the month of December 1970 are listed in satellite launch order and in time order for each satellite. Various subtotals are given. Author (ESRO)

**N71-33160*** Honeywell, Inc., Minneapolis, Minn.

**VOICE OPERATED CONTROLLER Patent**

David N. Lovinger, inventor (to NASA) Issued 22 Jun. 1971 12 p Filed 27 Feb. 1969 Sponsored by NASA
(NASA-Case-XLA-04063; US-Patent-3,586,261; US-Patent-Appl-SN-802948; US-Patent-Class-244-1; US-Patent-Class-179-1; US-Patent-Class-244-83) Avail: US Patent Office CSCL 22B

A voice operated controller for controlling the reaction jets of a space vehicle is described. A voice recognition apparatus is connected to a control. The control is connected to and controls the reaction jets. The voice recognition apparatus generates pulses in accordance with received voice commands. The pulses are applied to the control which interprets them. The control then applies suitable control signals to the reaction jets so that the desired command is carried out.
Official Gazette of the U.S. Patent Office

**N71-33195*#** National Aeronautics and Space Administration, Washington, D.C.

**ACOUSTIC LOADS GENERATED BY THE PROPULSION SYSTEM**

Jun. 1971 54 p refs
(NASA-SP-8072) Avail: NTIS CSCL 22B

A monograph which provides a uniform basis for the design of a flightworthy structure is presented. The monograph summarizes for use in space vehicle development the significant experience and knowledge accumulated in research, development, and operational programs to date. It can be used to improve consistency in design, efficiency of the design effort, and confidence in the structure.
Author

**N71-33286*#** LTV Aerospace Corp., Dallas, Tex. Missiles and Space Div.

**STUDY OF EFFECTS OF INCORPORATING A LARGER HEATSHIELD ON THE SCOUT VEHICLE Final Report**

24 Jul. 1969 368 p refs
(Contract NAS1-6935)
(CR-111947; Rept-23.411) Avail: NTIS CSCL 22B

Four heat shield diameters were evaluated, 40, 42, 44, and 46 inches. External shapes were defined and the effects of each size heat shield on vehicle stability and control, structure, and ground support equipment was determined. The first phase of this study is based on the Scout D configuration (Algol 3 motor installed). Increased fin area, control surface area, and control gains are required for all configurations. The impact on vehicle structure varies from virtually none with the 40 inch heat shield to almost complete vehicle redesign with the 46 inch heat shield. The 42-inch diameter heat shield was selected for the second phase of the study, to determine the effects of putting the larger heat shield on the Scout B configuration (Algol 2B motor installed). Increased fin tip control area and guidance system gains are required for this configuration. Structural changes are required on the heat shield attachment clamp. Author

**N71-33330*#** National Aeronautics and Space Administration, Washington, D.C.

**TUBULAR SPACECRAFT BOOMS (EXTENDIBLE, REEL STORED)**

Feb. 1971 52 p refs
(NASA-SP-8065) Avail: NTIS CSCL 22B

A monograph, covering the significant experience and knowledge accumulated in development and operational programs for spacecraft, is presented. It reviews and assesses current design practices, and from them establishes firm guidance for achieving greater consistency in design, increased reliability in the end product, and greater efficiency in the design effort. Author

**N71-33446*#** National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.

**THE DELTA LAUNCH VEHICLE CAPABILITIES, CONSTRAINTS AND COSTS FOR THE STRAIGHT 8, MODEL 2914 SERIES**

Charles R. Gunn Sep. 1971 33 p Submitted for publication
(NASA-TM-X-65674; X-470-71-328) Avail: NTIS CSCL 22A

A functional description of the vehicle, its performance, flight profile, flight environment, spacecraft integration requirements, user organizational interfaces, launch operations, and launch costs were provided. The new three stage Delta offers greater payload capability, an eight foot diameter spacecraft envelope, and greater available volume for attachment of secondary experiments or satellites to the expended orbiting second stage. The first stage Universal Boattail Thor (UBT) liquid propellant capacity was increased to 175,000 pounds from 145,000 pounds and the high performance H-1 engine developed for the Saturn 1B vehicle was adapted to the stage which can be thrust augmented with up to nine strap-on Castor 2 (TX-354-5) solid propellant motors, depending on mission performance requirements. The Delta second stage, recently uprated with a new propulsion system and a strap-down inertial guidance system, was suspended by an eight foot diameter adapter ring that joins the eight foot diameter UBT and new metal fairing. The third stage was the spin stabilized TE-364-4 solid propellant motor. Author

**N71-33543*#** National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.

**ACOUSTIC DATA FROM THE LAUNCH OF SCOUT S-172C (ESRO 1-B) AND SCOUT S-169 (GRS-A)**

J. A. Nagy Washington Sept. 1971 27 p ref
(NASA-TN-D-6369; G-1021) Avail: NTIS CSCL 22C

Acoustic data were obtained during the launch of the ESRO I-B spacecraft on 1 Oct. 1969, and the GRS-A spacecraft on 7 Nov. 1969, by Scout launch vehicles. The internal noise environment was monitored by a microphone located immediately below the spacecraft separation plane on S-172C. During both launches external

noise levels were measured by microphones located on the launcher. The highest internal sound pressure was observed at liftoff at an overall level of 133 dB over a 10- to 2000-Hz bandwidth. The highest overall external sound pressure was 149 dB, observed during liftoff. The Scout heat shield exhibits good noise-attenuation characteristics (15 to 25 dB) from 40 to 1000 Hz and readily transmits subaudio frequencies (10 to 20 Hz) as well as frequencies above 1000 Hz. The ring frequency of this heat shield is calculated to be 1236 Hz. In addition to the microphones, transducers were included in the S-172C flight experiment to measure the following performance parameters: steady and low-frequency accelerations, spin rate, motor pressure, tip-off, coning, chuffing, ambient pressure, and spacecraft separation. Author

**N71-33548#** National Aerospace Lab., Tokyo (Japan). Rocket Vehicle Structures Study Group.

**RESULTS OF STRUCTURAL EXPERIMENTS ON THE NAL-35DT ROCKET VEHICLE**

Nov. 1970 81 p refs In JAPANESE; ENGLISH summary
(NAL-TR-225) Avail: NTIS

The NAL-35DT rocket vehicle, which is characterized by having a single-stage solid propellant with two levels of thrust, was designed to place a 15 kg payload at an altitude of about 190 km. This report describes the results of structural experiments on the NAL-35DT rocket vehicle, including the pressure test of a filament-wound F.R.P. motor vessels, the strength test of the forward cap of motor chamber, the strength test of wing and wing fixtures, bending ragidity test and vibration test of the vehicle, and flutter wind tunnel test by a simulated wing model. A summary of the fundamental design of the vehicle system and the combustion tests of the motor on the ground is presented. Author

**N71-33600*#** National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.

**THE JOVIAN TURBOPAUSE PROBE. PART 1: THE SCIENTIFIC REQUIREMENTS FOR THE JOVIAN TURBOPAUSE PROBE**

Richard M. Goody, ed. (Harvard Univ.), George M. Levin, ed., W. Ian Axford (Calif. Univ.), A. G. W. Cameron (Yeshiva Univ.), and Donald M. Hunten (Kitt Peak Natl. Obs.) Dec. 1970 18 p refs
(NASA-TM-X-65671; X-110-70-442) Avail: NTIS CSCL 22B

A nonsurvivable probe (turbopause probe) is the simplest concept capable of direct measurements of the atmosphere and the interior of Jupiter. The scientific rationale and requirements for such a turbopause probe mission are discussed without reference to any specific year or deep space mission. A discussion of particles and fields measurements is included where these measurements are compatible with the prime mission objectives. Author

**N71-33709** Office National d'Etudes et de Recherches Aerospatiales, Paris (France).

**STUDY OF AEROSPACE MECHANISMS IN A STATE OF WEIGHTLESSNESS [ETUDE DES MECANISMES AEROSPATIAUX EN IMPESANTEUR]**

Roger Marguet and Jean Trichard 1971 27 p refs In FRENCH; ENGLISH summary Presented at 3d Intern. Conf. on Space Technol., Rome, 3–8 May 1971
(ONERA-TP-940) Avail: NTIS

To determine whether a spacecraft is spinning or not, a rig was devised to study such free fall mechanisms as rocket stage or satellite separation, yo-yo probe, or mast erection in space. Measurements are external (photographic) or internal (telemetry). The separated parts are recovered without damage. Several tests of French and European spacecraft, weighing up to 1000 kg, were performed. Author

**N71-33719*#** Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena. Engineering Mechanics Div.

**USE OF DERIVED FORCING FUNCTIONS AT CENTAUR MAIN ENGINE CUTOFF IN PREDICTING TRANSIENT LOADS ON MARINER MARS 1971 AND VIKING SPACECRAFT**

M. R. Trubert, J. R. Chisholm, and W. H. Gayman 28 Jun. 1971 81 p refs
(Contract NAS7-100)
(NASA-CR-121473; JPL-TM-33-486) Avail: NTIS CSCL 22A

The disturbing forcing functions of the Centaur engines at main engine cutoff derived from acceleration flight data of the Mariner Mars '69 spacecraft are used to predict acceleration and reaction forces and moments near the base of Mariner Mars '71 and Viking spacecraft. Mathematical dynamic models of the Mariner Mars '71 and Viking spacecraft and the Centaur launch vehicle modified for the Viking model are presented. Discussion concerning the method and the accuracy of the results are given. Author

**N71-33721*#** General Electric Co., Philadelphia, Pa. Missile and Space Div.

**POWER CONDITIONING EQUIPMENT FOR A THERMOELECTRIC OUTER PLANET SPACECRAFT Quarterly Technical Report**

Robert Andrews, Roman W. Andrycznyk, Sal Capodici, Theodore J. Ebersole, and Aaron Kirpich 15 Oct. 1970 318 p refs Prepared for JPL
(Contracts NAS7-100; JPL-952536)
(NASA-CR-121478; Rept-1J86-TOPS-650; QTR-3) Avail: NTIS HC $6.00/MF $0.95 CSCL 22B

Breadboard testing performed through October 1970 pertinent to the design and development of the electrical system and the power conditioning equipment for the TOPS (Thermoelectric Outer Planet Spacecraft) program is reported. A number of breadboard circuits were built and tested including quad redundant switching devices, quad redundant shunt regulators, high voltage conversion for TWT's, and dc to dc converters. Author

**N71-33727*#** Honeywell, Inc., Minneapolis, Minn. Systems and Research Div.

**CONTROLLER DESIGN TECHNOLOGY FOR THE SPACE SHUTTLE VEHICLE**

Jul. 1971 173 p refs
(Contract NAS8-25709)
(NASA-CR-119901; Rept-12238-IR1) Avail: NTIS CSCL 22B

Results of research conducted to develop a technology for control system design are summarized. The technology was aimed at providing control of flexure and rigid-body degrees of freedom of the space shuttle vehicle within constraints of practicality. The constraints apply to the controller configuration and to the design methods as well. The study has produced partial answers to three fundamental problems in optimal controller design: (1) controller simplification; (2) sensitivity to model inaccuracy; and (3) sensor complement choice. Positive results achieved in each of the three areas make it possible to apply the stochastic constrained-response technology to the design of a controller for mated ascent of the space shuttle vehicle. A.L.

**N71-33892** Maryland Univ., College Park.

**A NORMAL MODE ANALYSIS OF A SATELLITE EMPLOYING LONG FLEXIBLE BOOMS**

Forrest Edwin England (Ph.D. Thesis) 1969 204 p
Avail: Univ. Microfilms Order No. 70-15396

The dynamic deflections of long flexible antenna booms on a gravity gradient stabilized earth satellite are determined through the use of normal modes. The forcing terms which are derived are those due to gravity, thermal bending and orbital eccentricity. The booms are characterized by the first six normal modes of a cantilever and a three-dimensional analysis of the satellite proceeds using Lagrange's equations. The differential equations of

motion are given and the steady-state solution is obtained. The thermal bending generalized force is defined in terms of its Fourier components. The resulting boom deflections are given in terms of net tip deflection and in terms of the modal components. It is shown that the antenna boom shape is more easily interpreted when the deflections are given in terms of the modal components. Stability is investigated and a necessary condition for stability arising from the flexibility of the booms is derived. Dissert. Abstr.

# 32 STRUCTURAL MECHANICS

**Includes structural element design and weight analysis; fatigue; thermal stress; impact phenomena; vibration; flutter; inflatable structures; and structural tests. For related information see also: 17 Materials, Metallic; and 18 Materials, Nonmetallic.**

**N71-32860#** Southampton Univ. (England). Inst. of Sound and Vibration Research.

**STATIC ANALYSIS OF SANDWICH STRUCTURES BY THE FINITE ELEMENT METHOD**

K. M. Ahmed Apr. 1971 52 p refs Sponsored by Rohr Corp.
(ISVR-TR-48) Avail: NTIS

The static analysis of curved sandwich plates subjected to a uniformly distributed pressure has been carried out by the finite element displacement method using an element incorporating seven degrees of freedom per node. The effects of varying pressure and core orthotropy on static stresses and displacements have been investigated. Author (ESRO)

**N71-32884#** Syracuse Univ., N.Y.

**SURVEY OF RECENT WORK ON THE ANALYSIS OF DISCRETELY ATTACHED CORRUGATED SHEAR WEBS**

Charles Libove Jul. 1971 56 p refs Proposed for presentation at the AIAA/SME/SAE 13th Structures, Structural Dynamics, and Materials Conf., San Antonio, 10–12 Apr. 1972
Avail: NTIS

A summary and progress report on the theoretical analysis of stiffness, stresses, and deformations of corrugated shear webs with discrete, rather than continuous, attachment between the ends of the corrugations and the surrounding members are presented. Various kinds of discrete attachment are considered, and two kinds of corrugation cross section: the trapezoidal and the curvilinear, the latter having crests and valleys made up of identical circular arcs. The analyses presented employ the method of minimum total potential energy and the calculus of variations to obtain differential equations and boundary conditions governing the longitudinal variation of various component modes used to describe the deformations of a cross section. They are believed to be more accurate than previous analyses in that they generally permit more degrees of freedom in the assumed deformations. In particular, they abandon the assumption that the straight-line generators of the corrugation remain straight during the shearing of the web. Numerical results are presented in the form of graphs of stiffness and stresses for a variety of geometries and end-attachment conditions. Author

**N71-32918#** Chesapeake Coll., Wye Mills, Md.

**PROCEEDINGS OF THE 13th MEETING OF THE MECHANICAL FAILURES PREVENTION GROUP**

W. T. Sawyer 13 Apr. 1971 63 p refs Held at Greenbelt, Md., 19–20 Oct. 1970
(Contract N00014-69-C-0108)
(AD-724637; MFPG-7) Avail: NTIS CSCL 20/11

This is a report of two half-day discussions by a group of technical specialists of the topic Standards as a Design Tool in Surface Specification for Mechanical Components and Structures. The objectives were the study of the role of standards in surface specification and the identification of needed contents for a practical design manual. Interest was centered on processed, metallic surfaces intended to be subjected to significant stresses and/or environments, particularly surfaces of mating parts. Eight prepared talks, the ensuing audience discussions, and concluding recommendations are reported. Author (GRA)

**N71-32937#** Naval Ship Research and Development Center, Washington, D.C.

**COMPUTER PROGRAMS FOR PLATE VIBRATION INCLUDING THE EFFECTS OF CLAMPED AND ROTATIONAL BOUNDARIES AND CYLINDRICAL CURVATURE, OPTION 2 Final Report**

Ralph C. Leibowitz and Dolores R. Wallace Jan. 1971 166 p refs
(AD-724642; NSRDC-2976B) Avail: NTIS CSCL 13/10

A comparative study is made of various methods for computing the free vibration modes and natural frequencies of thin plates with clamped and rotational supports and cylindrical curvature. The methods include closed form analytical, digital computer, nomographic, and graphical computations. Based on the results, preferred methods of computation are recommended. These methods-Option 2-are of particular value in extending previously formulated digital computer programs for obtaining the vibroacoustic response to turbulence excitation of a plate. Computer results for a particular case provide a comparison of the effect of clamped-clamped and simply supported boundaries on the vibratory response of a plate subject to turbulence excitation. Author (GRA)

**N71-32959#** Chesapeake Coll., Wye Mills, Md.

**PROCEEDINGS OF MECHANICAL FAILURES PREVENTION GROUP (11th)**

W. T. Sawyer 13 Apr. 1971 48 p Conf. held at Williamsburg, Va., 7–8 Apr. 1970
(Contract N00014-69-C-0108)
(AD-724475; MFPG-5) Avail: NTIS CSCL 20/11

The document covers discussions by a group of technical specialists of the topic Mechanical Fatigue as a Critical Failure Mechanism. Sixteen prepared talks on the subject are summarized and the ensuing audience discussions reported. A technical summary of the complete proceedings is included. GRA

**N71-32974#** Brown Univ., Providence, R.I. Div. of Applied Mathematics.

**THE EFFECTS OF VARIOUS PARAMETERS ON AN AEROELASTIC OPTIMIZATION PROBLEM**

R. H. Plaut 1971 23 p refs
(Contract N00014-67-A-0191-0009)
(AD-724333) Avail: NTIS CSCL 1/3

The optimal design of a panel flutter problem is investigated. A semi-infinite flat panel with either a homogeneous or sandwich cross-section is considered. The thickness distribution of the panel is allowed to vary while the total weight is held fixed, and the distribution which maximizes the critical flutter parameter for stability is chosen as the optimal design. This design is calculated here by means of a generalized Ritz procedure, with the panel thickness assumed to have a certain form. Variations in the following parameters are then considered: a minimum allowable thickness, aerodynamic damping, inplane loading, and non-structural stiffness and mass for the case of a sandwich panel. It is shown that the optimal design may be significantly affected by changes in these parameters. Author (GRA)

**N71-32978#** California Univ., Berkeley. Div. of Applied Mechanics.

**SOME REMARKS ON ELASTIC-PLASTIC DEFORMATION AT FINITE STRAIN**
A. E. Green and P. M. Naghdi Mar. 1971 25 p refs
(Contract N00014-69-A-0200-1008)
(AD-724319; AM-71-3) Avail: NTIS CSCL 20/11

A number of papers, e.g., by Lee and Liu, have appeared recently which are concerned with a non-isothermal theory of large elastic-plastic deformations. This theory is not entirely satisfactory in the sense that not all of its constitutive equations are invariant under superposed rigid body motions. Moreover, apart from this defect (and aside from certain ad hoc thermodynamical assumptions employed), the limitations of this theory and its relationship to the more general thermodynamical theory of Green and Naghdi has not been made clear. The present paper is intended to provide the needed clarifications pertaining to the above remarks. Author (GRA)

**N71-32982#** Pennsylvania State Univ., University Park. Dept. of Engineering Mechanics.
**FINITE ELEMENT FOR TIMOSHENKO BEAM BASED ON MECHANICAL IMPEDANCE Progress Report, Mar. 1970–Apr. 1971**
V. P. Rangaiah and V. H. Neubert Apr. 1971 133 p refs
(Contract N00014-67-A-0385-0010)
(AD-724332; PR-1) Avail: NTIS CSCL 13/13

A finite element model for representation of a Timoshenko beam segment is derived. The model is a massless beam, having bending and shear flexibility, carrying concentrated masses on rigid arms to account for translatory and rotary inertia. The accuracy of the model is domonstrated by comparing its impedance and ground shock response to those of the exact Timoshenko beam, the exact Bernoulli-Euler beam, and center-of-gravity lumped mass models. Author (GRA)

**N71-33009#** Oxford Univ. (England). Dept. of Engineering Science.
**OPTIMUM DESIGN OF A GIRDER OF UNIFORM DEPTH**
W. S. Hemp Nov. 1970 13 p ref
(Rept-1124/70) Avail: NTIS

From the simple case of a Warren truss and minimum quantity of material for a cantilever under tip load, the Michell continuum is studied and a layout for shearbracing, consisting of cycloids, is shown to give a solution for not too short cantilevers. This layout is optimized regarding the volume of material required. ESRO

**N71-33034#** Watervliet Arsenal, N.Y.
**STRESS INTENSITY FACTORS FOR INTERNALLY PRESSURIZED THICK-WALL CYLINDERS**
John H. Underwood May 1971 26 p refs
(AD-724641; WVT-72124) Avail: NTIS CSCL 13/4

Selected stress intensity factor solutions from the literature are related to the problem of internally pressurized thick-wall cylinders with straight-front and curved-front cracks. The recent K solutions of Bowie + Freese and Rice + Levy are combined in an estimate of the K solution for a pressurized cylinder with a semielliptical crack originating along the inner wall. The estimate of K is compared with the available experimental and analytical K data for shallow cracks. The estimated K solution is modified to account for various complex loadings in pressurized cylinders. Included are modifications to describe lack of pressure on the crack surfaces in pressurized cylinders, residual stress in the wall of pressurized cylinders, a combination of an unpressurized crack and residual stress in the wall. The effect of cylic pressure loading on K is also discussed in relation to Throops work on fatigue of pressurized cylinders. Author (GRA)

**N71-33043#** Southampton Univ. (England). Inst. of Sound and Vibration Research.
**FREE VIBRATIONS OF CURVED SANDWICH BEAMS**
K. M. Ahmed Mar. 1971 44 p refs Sponsored by Rohr Corp.
(ISVR-TR-45) Avail: NTIS

The finite element displacement method is used to investigate the flexural vibration characteristic of curved sandwich beams. Three displacement models are used, incorporating an element having three, four, and five degrees of freedom per node and various parametric studies made to investigate their effect on the natural frequencies. Author (ESRO)

**N71-33066#** Ballistic Research Labs., Aberdeen Proving Ground, Md.
**UNIQUENESS OF SHOCK REFLECTION PATTERNS IN ELASTIC SOLIDS**
Thomas W. Wright Feb. 1971 28 p refs
(AD-724137; BRL-1535) Avail: NTIS CSCL 20/11

An oblique shock wave incident upon a plane boundary of a non-linear simple elastic solid is shown to give rise to a unique reflection pattern if the angle of incidence is less than the critical angle. Author (GRA)

**N71-33134#** North Carolina State Univ., Raleigh. Dept. of Mechanical and Aerospace Engineering.
**MATHEMATICAL MODEL FOR THE FREE VIBRATION OF AN ARC WITH VARYING RADIUS OF CURVATURE**
James R. Rutledge and Larry H. Royster Apr. 1971 17 p refs Presented at the Meeting of the Acoust. Soc. of Am. (81st), Washington, D.C., 20–23 Apr. 1971
(Contract Nonr-486(11))
(AD-724318; TR-15) Avail: NTIS CSCL 20/11

A mathematical model for the symmetric and antisymmetric free vibrations of an arc with varying radius of curvature is developed. The arc is approximated by a discrete set of equations and the model is developed for varying cross sectional geometry (taper and thickness). Digital computer solutions for the matrix eigenvalue problem are discussed for the pinned-pinned and clamped-radially guided boundary conditions. Vibration coefficients are presented for various elliptical cases with taper and thickness variations. Author (GRA)

**N71-33141*#** Syracuse Univ. Research Inst., N.Y. Dept. of Mechanical and Aerospace Engineering.
**THEORETICAL STUDY OF CORRUGATED PLATES: SHEARING OF A TRAPEZOIDALLY CORRUGATED PLATE WITH TROUGH LINES HELD STRAIGHT**
Chuan-jui Lin and Charles Libove Washington NASA Aug. 1971 126 p refs
(Grant NGR-33-022-115)
(NASA-CR-1749; MAE-1833-T1) Avail: NTIS CSCL 20K

A theoretical analysis is presented of the elastic shearing of a trapezoidally corrugated plate with discontinuous attachment at the ends of the corrugations and with trough lines constrained to remain straight. Numerical results on effective shearing stiffness, stresses, and displacements are presented for selected geometries and end-attachment conditions. It is shown that the frame-like deformations of the cross sections, which result from the absence of continuous end attachment, can lead to large transverse bending stresses and large reduction in shearing stiffness. Some suggestions are made for reducing these effects. Author

**N71-33204*#** Illinois Univ., Urbana. Dept. of Theoretical and Applied Mechanics.
**CREEP DEFORMATION BEHAVIOR OF METALS UNDER REPEATED STRESS REVERSALS Final Report**

Masaki Kitagawa and Jo Dean Morrow Jun. 1971 42 p refs
(Grant NGR-14-005-025)
(NASA-CR-72949; UILU-ENG-71-6006; TAM-342) Avail: NTIS CSCL 20K

Reversed creep tests on chemical lead, 1100-F aluminum and OFHC copper were conducted and creep deformation behavior under repeated stress reversals was studied. Metallographic observations were also made to determine the nature of the structural alteration accompanying reversed creep deformation. It is shown that the creep deformation resistance of a variety of metals is reduced by repeated reversed deformation at temperatures above 0.4T(m), where T(m) is the absolute melting temperature of each metal. The reduction of creep deformation resistance due to stress reversals is most prominent at approximately 0.5 T(m), and it is of a persistent nature. Metallographic studies show that the observed acceleration of creep at high temperatures is in part due to the enhancement of grain boundary sliding as a result of gradual grain boundary migration toward planes of maximum shear stress during reversed creep deformation. Author

N71-33247*# National Aeronautics and Space Administration Lewis Research Center, Cleveland, Ohio.
**DEFLECTION ANALYSIS OF DAMPED ROTORS WITH HARMONIC SUPPORT FORCES**
Richard H. Cavicchi Aug. 1971 71 p refs
(NASA-TM-X-67896; E-6504) Avail: NTIS CSCL 20K

A theoretical solution of the equations of motion was developed for damped rigid rotors with harmonic forces at the supports. Support deflection amplification and the phase angles between the displacements and the harmonic forces were computed. The harmonic forces represent the effects at the supports of unbalance forces whose planes of unbalance were assumed to have an equal distribution for the probability of their axial locations. Also, support stiffness and damping characteristics were assumed to be symmetrical. Under these conditions, which were representative of cylindrical roller bearings in rigid pedestals, a low speed resonance appeared when the center of gravity did not lie on the midplane. Other calculations showed that even with a midplane center-of-gravity location, a low speed resonance occurred for slender rotors but not for disks. Deflection amplification at low speed resonances was generally smaller than at the major critical speed. Author

N71-33303*# MacNeal-Schwendler Corp., Los Angeles, Calif.
**A DESIGN STUDY FOR THE INCORPORATION OF AEROELASTIC CAPABILITY CAPABILITY INTO NASTRAN**
Robert L. Harder, Richard H. MacNeal, and William P. Rodden May 1971 271 p refs
(Contract NAS1-9801)
(NASA-CR-111918) Avail: NTIS CSCL 20K

The basic computational tasks required for solution of both static and dynamic aeroelastic problems are discussed along with the modifications and additions to the NASA Structural Analysis Program that are required to add an aeroelastic capability. New functional modules and rigid formats are outlined. Special emphasis is placed on flutter analysis. Author

N71-33316*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
**ENERGY EXCHANGES DURING THE PARTIALLY INELASTIC IMPACT OF TWO MASSES HAVING COLLINEAR VELOCITIES**
R. E. Morris Aug. 1971 16 p refs
(NASA-TM-X-67917; E-6544) Avail: NTIS CSCL 20K

An expression was developed for the kinetic energy transformed into work, heat, and sound during the impact of a model of a spherical reactor containment vessel and a concrete block. The expression was a function of the masses, Newton's coefficient of restitution, and the initial velocities of the two masses. The energy transformed was shown to be constant for two given masses with a given coefficient of restitution impacted at a constant relative velocity between the masses. The total energy transformed into work, heat, and sound was shown to be less than the kinetic energy of the smaller mass due to the relative velocity between the masses. Author

N71-33331*# National Aeronautics and Space Administration, Washington, D.C.
**BUCKLING STRENGTH OF STRUCTURAL PLATES**
Jun. 1971 50 p refs
(NASA-SP-8068) Avail: NTIS CSCL 20K

A monograph is presented which provides a uniform basis for the design of a flightworthy space vehicle structure. It summarizes for use in space vehicle development the significant experience and knowledge accumulated in research, development, and operational programs to date. It can be used to improve consistency in design, efficiency of the design effort, and confidence in the structure. Author

N71-33373# North Carolina State Univ., Raleigh. Mathematics Research Group.
**FOURIER TRANSFORM SOLUTIONS OF QUARTER-PLANE PROBLEMS IN ELASTICITY**
Ian N. Sneddon 1 May 1971 72 p refs
(Grant AF-AFOSR-1779-69)
(AD-724176; AFOSR-71-1567TR) Avail: NTIS CSCL 20/11

The object of these notes is to present a systematic account of an integral transform method of solving boundary value problems of classical plane elastostatics for a quarter plane. Of the problems presented here the main emphasis is on mixed boundary value problems. The principal reason for this is not that problems concerning a quarter-plane have any intrinsic interest, but that certain two-dimensional problems involving line cracks can by their symmetry be reduced to mixed boundary value problems for a quarter plane. The methods developed here can be used to derive the solutions of more complicated crack problems and of contact problems involving a quarter-plane or two quarter-planes adhering to each other. GRA

N71-33423# Cornell Univ., Ithaca, N.Y. Dept. of Theoretical and Applied Mechanics.
**ON THERMAL STRESSES IN BEAMS**
Bruno A. Boley May 1971 21 p refs
(Contract N00014-67-A-0077-0009)
(AD-724404; TR-5) Avail: NTIS CSCL 13/13

Elementary calculations for the axial thermal stresses in beams are compared with those of an exact theory, and estimates of the difference between the two are given for several important special cases, including that of thin-walled beams. It is found that the error in the elementary theory is quite large in certain cases (for example that of a circular section with axisymmetric temperature). Author (GRA)

N71-33447*# Stanford Univ., Calif. Dept. of Aeronautics and Astronautics.
**AN APPLICATION OF CONTROL THEORY METHODS TO THE OPTIMIZATION OF STRUCTURES HAVING DYNAMIC OR AEROLASTIC CONSTRAINTS**
Terrence A. Weisshaar Oct. 1970 174 p refs
(Grant NGL-05-020-243; Contract F44620-68-C-0036)
(NASA-CR-121458; SUDAAR-412; AFOSR-70-2862TR) Avail: NTIS CSCL 20K

Some simple structures whose weights are minimized subject to several types of constraints involving fixed eigenvalues are investigated. These eigenvalues may be related to free vibration, in

which case a least weight structure is determined while holding one or more natural frequencies constant. Similarly, the eigenvalues may be related to aeroelastic instabilities where a least weight structure is found while holding the flutter speed constant. With one exception, the models are idealized one dimensional structures with fixed geometry and spatial dimensions. These models are adequately described by a set of N simultaneous first-order ordinary differential equations which come from the general Nth order equilibrium equation. Methods adapted from optimal control theory are used to develop differential equations and boundary conditions which are necessary to ensure optimality. This optimization problem then becomes a two point boundary value problem with 2N simultaneous nonlinear differential equations. The solution method used to solve these equations is an adaptation of a numerical technique used on optimal control theory which is referred to as the transiton matrix procedure. This method involves perturbing the optimality equations and boundary conditions to find successive neighboring extremal solutions until the optimum design is reached. Author

**N71-33498*#** Brown Univ., Providence, R.I. Div. of Engineering.
**THE PART-THROUGH SURFACE CRACK IN AN ELASTIC PLATE**
J. R. Rice and N. Levy Sep. 1970 42 p refs
(Grant NGL-40-002-080/3)
(NASA-CR-121428) Avail: NTIS CSCL 20K

An elastic analysis is presented for the tensile stretching and bending of a plate containing a surface crack. The two-dimensional generalized plane stress and Kirchhoff–Poisson plate bending theories are employed, with the part-through cracked section represented as a continuous line spring. The spring has both stretching and bending resistance, its compliance coefficients being chosen to match those of an edge cracked strip in plane strain. The mathematical formulation reduces finally to two coupled integral equations for the thickness averaged force and moment per unit length along the cracked section. Results are given for the stress intensity factor at the midpoint of the part-through crack for both remote tensile and bending loads on the plate. These results indicate significant load shedding to uncracked regions of the plate, in that the stress intensity factor is substantially lower than for a similarly loaded strip in plane strain with a crack of the same depth. Author

**N71-33575#** Los Alamos Scientific Lab., N.Mex.
**STRESS CALCULATIONS IN MAGEE DIFFERENCE FORM**
Patrick J. Blewett Dec. 1970 10 p refs
(Contract W-7405-eng-36)
(LA-4601) Avail: NTIS

MAGEE is the name of a two dimensional Lagrangian hydrodynamics code in use at the Los Alamos Scientific Laboratory. A method is suggested for the extension of MAGEE so that flows containing elastic and plastic effects may be computed. The Prandtl-Reuss theory was used to describe the plastic regime and the appropriate differences equations were derived. Author

**N71-33586** Michigan State Univ., East Lansing.
**PLASTIC WAVE PROPAGATION WITH COMBINED STRESSES**
Ram Parkash Goel (Ph.D. Thesis) 1969 188 p
Avail: Univ. Microfilms Order No. 70-15035

Combined-stress wave propagation for loading beyond the elastic limit in two geometries: a thin-walled semi-infinite tube subjected to simultaneous axial and torsional impact, and a half space under compressive and shear impact loadings are analyzed. The major part of the results presented are for the thin-walled tube case, where the effect of different hardening assumptions has been investigated. For the half space, isotropic hardening was assumed throughout the study. One type of simple-wave solution not previously investigated is presented and also one example of a numerical solution for a nonsimple wave. Dissert. Abstr.

**N71-33672*#** National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
**WAVE SURFACES DUE TO IMPACT ON ANISOTROPIC FIBER COMPOSITE PLATES**
Francis C. Moon Washington Sep. 1971 24 p refs
(NASA-TN-D-6357; E-6150) Avail: NTIS CSCL 20K

The application of advanced fiber composite materials to the fabrication of fan or compressor blades depends on their ability to sustain limited damage under impact forces. For small objects such as pebbles or hailstones, the impact times are of the order of microseconds. Thus the energy transmission to the blade is completed before there are any or many reflections from the boundaries. The stress waves induced in anisotropic plates by transverse, short-duration impact forces are examined. The anisotropy is related to the layup angles of the fibers. Using a modification of Mindlin's approximate theory of plates, it is shown that both extensional and bending waves are generated by transverse impact. The magnitudes of the wave velocities in different directions are calculated for graphite fiber-epoxy matrix plates as well as boron-aluminum and glass-epoxy systems for various layup angles. Finally the shapes of the waves fronts or wave surfaces due to point impact are also presented for the cases mentioned. Author

**N71-33714#** California Univ., Livermore. Lawrence Radiation Lab.
**IDENTIFICATION OF DYNAMIC SYSTEMS FROM EXPERIMENTAL DATA**
David F. Hillyer 2 Feb. 1971 68 p refs Presented at the Exptl. Stress Analysis Meeting, Salt Lake City, Utah, 18 May 1971 Sponsored by AEC Revised
(UCRL-72818-Rev-1; Conf-710502-2-Rev-1) Avail: NTIS

Laboratory vibration tests were performed to provide the experimental data for an analytical modal path model of a structural system. With modal path numerical parameters, a lumped-mass model of the system was constructed. Modal path analysis of dynamic system identification was compared with results of a simple mechanical impedance experiment and showed the same responses as the experiment. Model response to an analytical transient was compared with the response of the experiment to an induced transient to verify the accuracy of the computer simulation. Author

**N71-33770** Connecticut Univ., Storrs.
**VISCOELASTIC AND INELASTIC RESPONSE AND STABILITY OF SPHERICAL STRUCTURAL SYSTEMS IN FLUID MEDIA**
Bijoy Krishna Bhattacharya (Ph.D. Thesis) 1970 103 p
Avail: Univ. Microfilms Order No. 70-15527

The dynamic response and stability of submerged structural systems composed of a sphere joined by a connecting member and attached to a base foundation medium is studied. The fluid force employed in the investigation was determined by Basset and includes a viscous drag term dependent on the instantaneous velocity of the system, an added mass term which varied with the instantaneous acceleration of the system, and a history integral term, which takes into account the previous motion of the system and its affect on present fluid-structure interaction. Linear viscoelastic constitutive relationships of the generalized Maxwell and Kelvin model types as well as nonlinear relations in the form of Ramberg-Osgood functions are assumed for the connecting members. Dissert. Abstr.

**N71-33777*#** North Carolina State Univ., Raleigh. Dept of Engineering Mechanics.

**ON DISPERSION AND CHARACTERISTIC MOTIONS OF TEMPERATURE RATE DEPENDENT MATERIALS**

Ghodratollah Nowrooz Haddad and Tien Sun Chang Washington NASA Sep. 1971 93 p refs
(Grant NGL-34-002-084)
(NASA-CR-1795; TSC-70-1) Avail: NTIS CSCL 20K

A general three dimensional theory of a thermomechanical material which can be a metallic or polymeric medium, or a structured composite, is developed using the modern techniques of axiomatic continuum mechanics and the laws of thermodynamics. One dimensional linear spatial gradient temperature rate dependent theories are presented for both thermoviscoelastic and thermoelastic materials. The characteristic motions are considered and it is shown that, due to the presence of temperature rate effects, thermal propagation speeds have finite values. A comprehensive study of the dispersion relations is presented and illustrated graphically for typical values of the material constants. Analytical expressions are obtained for both high and low frequency responses. It is demonstrated that the characteristic speeds coincide with the high frequency asymptotic phase velocities in both cases. Physical and numerical limitations on the material constants are obtained for stable wave propagations. A class of self-similar solutions is obtained for the temperature rate dependent thermoelastic medium using the theory of continuous group of transformations. Author

**N71-33778*#** Virginia Polytechnic Inst., Blacksburg. Dept. of Engineering Mechanics.

**AN EXPERIMENTAL AND ANALYTICAL INVESTIGATION OF THE DUCTILE FRACTURE OF POLYMERS**

H. F. Brinson, H. Gonzalez, and C. W. Stormont Jun. 1971 94 p refs
(Grant NGR-47-004-051)
(NASA-CR-121416; VPI-E-71-10) Avail: NTIS CSCL 20K

The analytical portion represents an adaptation of the Dugdale model to include the effect of a uniform shear stress at the elastic-plastic interface. The solution is formulated using a complex variable approach. The effect of assuming the existence of a uniform shear stress along the plastic zone boundary is to introduce a weak logarithmic singularity at the tip of the plastic zone. The solution demonstrates the admissibility of stress states along the elastic-plastic boundary other than that normally assumed for the Dugdale model. The results of the modified problem are compared to Dugdale's predictions. The experimental aspect represents an evaluation of an earlier investigation extending the Dugdale mathematical model to include material anisotropy. Experiments were conducted on orthotropic sheets of polycarbonate in which the desired preorientation was produced by a rolling process. Crack opening displacements were measured as a means of qualitatively verifying the theory. Crack extension was observed to deviate from the original crack line depending on initial crack orientation with respect to material orthotropy. Author

**N71-33805#** Politecnico di Torino (Italy). Scovala di Ingegneria Aerospaziale.

**THE THEORY OF AEROELASTIC MODELS [LA TEORIA DEI MODELLI AEROELASTICI]**

Giuseppe Surace 1970 44 p refs In ITALIAN
Avail: NTIS

The model theory is examined for static- and dynamic-aeroelastic phenomena. The results are applied to divergence and flutter. Transl. by F.O.S.

**N71-33819#** McGill Univ., Montreal (Quebec). Dept. of Mechanical Engineering.

**DYNAMICAL ANALYSIS OF AXIALLY NON-UNIFORM, THIN CYLINDRICAL SHELLS. PART 1: MATRIX FORMULATION**

A. A. Lakis and M. P. Paidoussis Dec. 1970 49 p refs
(MERL-70-9-Pt-1) Avail: NTIS CSCL 20K

A theory for the dynamical and static analysis of axially nonuniform, thin cylindrical shells was presented. It was a hybrid of finite element and classical shell theories: the shell was subdivided into cylindrical finite elements, and the displacements within each (expressed in terms of nodal displacements), i.e. the displacement functions, were obtained using Sanders' equations for thin cylindrical shells in full. Sanders' theory gave zero strains for small rigid-body motions, so that displacement functions based on it satisfied the convergence criteria of the finite-element method. Expressions for the mass, stiffness and stress-resultant matrices were obtained, and the method for constructing the equivalent global matrices was given. Author

**N71-33822#** Indian Inst. of Science, Bangalore. Dept. of Aeronautical Engineering.

**DESIGN DATA ON BUCKLING OF CLAMPED SKEW PLATES (OBLIQUE COMPONENTS). PART 1: INDIVIDUAL LOADING**

Mahabaliraja and S. Durvasula May 1971 73 p refs
(AE-296-S) Avail: NTIS

The buckling problem of clamped skew plates under individual loading is considered, by employing oblique component stress representations. The Ritz method is applied with the deflection expressed in terms of a double series of beam characteristic functions of a uniformly clamped beam. Convergence studies are made in detail for each type of individual loading. The numerical results are computed for wide ranges of plate configurations and presented in the form of tables and graphs. Some interesting features associated with buckling behavior under shear are also discussed. Author

**N71-33866** Illinois Inst. of Tech., Chicago.

**DYNAMIC PHOTOELASTIC ANALYSIS OF THE QUARTER-PLANE**

Alan Norman Henzi (Ph.D. Thesis) 1970 199 p
Avail: Univ. Microfilms Order No. 70-17251

The elastodynamic response of a free-free quarter-plane following a single concentrated pulse load applied to one of the edges at a distance from the corner is studied. Attention is focused upon the interactions of the half-plane waves (P, S, PS, R), generated by the load, with the sharp corner and the unloaded edge of the model. The experimental techniques of dynamic photoelasticity and dynamic interferometry are employed in the experimental tests. Relative retardation data were obtained utilizing a light-field circular polariscope with a Cranz–Schardin multiple spark-gap camera. Similarly, a single spark-gap camera was utilized with a three-mirror series interferometer to record the absolute retardation data. The test models were machined from commercially cast sheets of CR-39 resin and were loaded by explosive lead azide charges, which were detonated by bridgewires. Dissert. Abstr.

**N71-33871#** Naval Research Lab., Washington, D.C.

**REPORT OF NRL PROGRESS**

Jul. 1971 32 p refs
Avail: NTIS

The tensile ligament instability model of fracture was extended to include static fatigue, but with repeated reloadings to represent fatigue crack propagation, in a study of strain hardening and stress relaxation effects on fatigue crack propagation. Progress in the following areas was also reported: radial heat conduction in laser heating of material slabs, applications for antennas exhibiting retrodirective properties, physical metallurgy of high temperature materials, assessment of postirradiation notch ductility of 9Ni-4Co-0.20C steel weldment, holographic study of dendrite morphology, the influence of thickness on the fracture toughness parameter for high strength metal alloys, ductile fracture equation for nonferrous structural metals, resistance to fatigue crack growth

of cold worked stainless steel at high temperature, electrochemical potential of high purity metals in seawater, plastic flowing and fracture, demonstration of collisionless interactions between counterstreaming ions in a laser produced plasma experiment and deterioration of optical surfaces by the formation of intermetallic compounds. J.G.M.

**N71-33904** Florida Univ., Gainesville.
**EFFECT OF THE YIELD CRITERION ON THE DYNAMIC ELASTIC/VISCOPLASTIC FLOW OF SOLIDS**
Hans Robert Fuehrer (Ph.D. Thesis) 1969 256 p
Avail: Univ. Microfilms Order No. 70-14878

The two principle yield criteria of the theory of plasticity, Mises and Tresca, were compared in theory of viscoplasticity. To make these comparisons the following approach was taken: (1) develop a rate dependent plastic flow equation compatible with the Tresca criterion, (2) show where both criteria reduce to the same relations, (3) select two problems in which the criteria provide differences in flow equations, and (4) solve the above problems to provide numerical values for comparisons. Two problems, the dynamic expansion of an incompressible, cylindrical tube and cylindrical, radial wave propagation were chosen. Results from the solution to these problems indicate that in general the material behavior is the same for both yield criteria. For those conditions where identical material behavior is not predicted, the same general material response is predicted. Results also show that qualitatively, the Tresca and Mises criteria predict the same mechanical response of elastic/viscoplastic materials; although, quantitatively, large differences may occur in the prediction of the stresses, strains, and particle velocity. Dissert. Abstr.

**N71-33948** Colorado Univ., Boulder.
**ON THE CONTACT OF PLATES OF VARIABLE THICKNESS**
Michael Burke McGrath (Ph.D. Thesis) 1969 92 p
Avail: Univ. Microfilms Order No. 70-16505

The problems of an axisymmetric plate of variable thickness contacting a rigid smooth surface and of two axisymmetric plates of variable thickness in contact are investigated. The analysis is carried out within the framework of a linear plate theory that relaxes the Kirchoff hypothesis and includes both the effect of transverse shear deformation and thickness variation. A general method of solution is indicated for both classes of problems considered. Specific examples involving numerical results are included to illustrate the conceptual and practical significance of the inclusion of shear deformation in the treatment of problems of this type. Dissert. Abstr

**N71-33960#** New South Wales Univ., Kensington (Australia). Dept. of Structural Mechanics.
**A STUDY OF THERMOELASTIC LAMINATED ANISOTROPIC ARBITRARY CYLINDRICAL SHELLS**
A. K. Noor Aug. 1970 122 p refs
(UNICIV-R-59) Avail: NTIS

A variational derivation is presented of the governing differential equations of the mixed formulation for the linear, dynamic problem of thermoelastic laminated anisotropic arbitrary cylindrical shells. The study is based on a generalized Sanders–Budiansky first-order shell theory with the effects of transverse shear deformation, anisotropic material behavior and rotary inertia included. A modified form of Reissner's variational principle is used to obtain the governing equations of two variants of the mixed formulation. The two formulations were used, in conjunction with a higher order modified finite difference method, to study the effect of shear deformation on the bending of normally loaded transversely isotropic and laminated orthotropic oval shells. The two cases of simply supported and clamped edges have been studied. The significance of the shear deformation is ascertained by comparing the numerical solutions obtained using the shear deformation theory to those of the classical theory for a large number of geometric and lamination (or material) parameters. The effect of bending-extensional coupling for shells with nonsymmetrical lamination about the middle surface has also been studied. Author

**N71-33971** Rutgers Univ., University Park, N.J.
**A GRADIENT-DIRECT SEARCH ALGORITHM FOR AUTOMATED OPTIMUM DESIGN**
Michael Peppas (Ph.D. Thesis) 1970 155 p
Avail: Univ. Microfilms Order No. 70-16947

The constrained optimization problem usually encountered in automated design is transformed into an unconstrained formulation through the use of penalty functions. The formulation creates a ridge on the composite merit surface at the acceptable-unacceptable region boundary. A gradient search is used to start the design synthesis. This search method, conventionally employed in the acceptable region, is extended for use in the unacceptable region, making any starting point admissible. The penalty functions are constructed so as to form a reasonably symmetrical ridge at this boundary in order to increase the efficiency of the direct search. This symmetry also improves the effectiveness of the optimality check procedure employed to determine if the point of direct search failure is optimum and to locate a new search direction if it is not. The resulting optimum search procedure is called the composite surface algorithm. Dissert. Abstr.

**N71-33986#** Royal Aircraft Establishment, Farnborough (England).
**RADIOGRAPHIC MEASUREMENTS OF RESIDUAL STRESSES IN ELECTRON BEAM WELDED SPECIMENS [ROENTGENOGRAPHISCHE EIGENSPANNUNGSMESSUNGEN AN ELEKTRONENSTRAHLGESCHWEISSTEN PROBEN]**
R. Pruemmer Apr. 1971 22 p refs Transl. into ENGLISH from DVS Berichte, v. 5, 1969 p 63–69
(RAE-LIB-Trans-1556) Avail: NTIS

Results are presented of X-ray investigations of residual stresses in electron beam welded 0.32% carbon steel test pieces. The effect of two different weld conditions on the residual stress state is discussed. It was found that the different weld conditions affected the residual stresses and it was confirmed that the X-ray method provided a suitable means of determining the residual stresses in electron beam welded parts. Author

# 33 THERMODYNAMICS AND COMBUSTION

Includes ablation, cooling, heating, heat transfer, thermal balance, and other thermal effects; and combustion theory. For related information see also: 12 Fluid Mechanics; and 27 Propellants.

**N71-32826#** National Bureau of Standards, Washington, D.C. Analytical Chemistry Div.
**PROCEEDINGS OF A SYMPOSIUM ON THE CURRENT STATUS OF THERMAL ANALYSIS**
Oscar Menis, ed. Oct. 1970 187 p refs Symp. held at Gaithersburg, Md., 21–22 Apr. 1970
(NBS-SP-338) Avail: SOD $1.00

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**N71-32827#** Akron Univ., Ohio. Dept. of Chemistry.

**STANDARDIZATION OF DIFFERENTIAL THERMAL ANALYSIS TEST METHODS**

Paul D. Garn *In* NBS Proc. of a Symp. on the Current Status of Thermal Analysis Oct. 1970 p 1–22 refs (See N71-32826 20-33)

Avail: SOD $1.00

The appearance of a differential thermal analysis curve depends greatly, for many materials, upon the method of experimentation. This is because the physical properties of the specimen will have differing effects upon the actual events taking place. The experimental parameters, mainly the sample holder and atmosphere, should be selected to learn as much as possible about the properties of most interest. The use of a single set of conditions as a general practice is ineffective. Author

**N71-32828#** National Bureau of Standards, Washington, D.C. Physical Chemistry Div.

**MACROCALORIMETRY: HOW ACCURATE?**

K. L. Churney, G. T. Armstrong, and E. D. West *In its* Proc. of a Symp. on the Current Status of Thermal Analysis Oct. 1970 p 23–59 refs (See N71-32826 20-33)

Avail: SOD $1.00

The measurement theory of isoperibol and adiabatic shield calorimeters operated by the method of intermittent heating is reviewed and recent developments indicated. Implications of the theory in terms of calorimeter design and tests for systematic errors are discussed. Some idea of the magnitude of calorimetric errors (as compared to errors arising from uncertainties in the change of state of the system under study) is outlined. Author

**N71-32829#** National Bureau of Standards, Washington, D.C. Analytical Chemistry Div.

**STATUS OF THERMAL ANALYSIS TEMPERATURE SCALE STANDARDS**

O. Menis and J. T. Sterling *In its* Proc. of a Symp. on the Current Status of Thermal Analysis Oct. 1970 p 61–86 refs (See N71-32826 20-33)

Avail: SOD $1.00

Current status in the development of suitable temperature scale standards for differential thermal analysis is described. It involves the collection and evaluation of data on 12 materials. The selected temperature values depend on the transition temperature of a number of compounds as well as two low temperature melting metals. The temperature scale region of 40 to 900 C is covered effectively with the ten materials, which serve as calibration standards. Author

**N71-32830#** Oklahoma State Univ., Stillwater. Dept. of Chemistry.

**HIGH TEMPERATURE DIFFERENTIAL THERMAL ANALYSIS**

Robert D. Freeman *In* NBS Proc. of a Symp. on the Current Status of Thermal Analysis Oct. 1970 p 87–98 refs (See N71-32826 20-33)

Avail: SOD $1.00

Three areas are discussed: (1) high temperature (larger than 1900 K) differential thermal analysis (DTA); (2) some problems in conventional high temperature calorimetry, which may be relevant to high temperature dynamic calorimetry; and (3) a brief description of efforts to achieve dynamic calorimetry to at least 1300 K. Author

**N71-32831#** Massachusetts Univ., Amherst. Dept. of Polymer Science and Engineering.

**THERMAL STUDIES ON LIPID WATER SYSTEMS BY DIFFERENTIAL SCANNING CALORIMETRY WITH REFERENCE TO ATHEROSCLEROSIS**

G. Jerry Davis and Roger S. Porter *In* NBS Proc. of a Symp. on the Current Status of Thermal Analysis Oct. 1970 p 99–117 refs (See N71-32826 20-33)

(Grant NIH 11342) Avail: SOD $1.00

Liquid-water systems have been studied by differential scanning calorimetry. Three component systems were investigated. The components consisted of a phospholipid, cholesterol or one of its esters, and water. Temperatures and heats of transition for these systems were investigated. The results revealed considerable differences in the stability of complexes formed in these ternary systems with the unsaturated esters generally leading to the least stable structures. The morphologies likely represented compositions and orders similar to the layered structures observed for biological membranes and the deposition of atherosclerotic plaques. Author

**N71-32832#** National Bureau of Standards, Washington, D.C. Inst. for Materials Research.

**AN ANALYTICAL EVALUATION OF DIFFERENTIAL SCANNING CALORIMETRY (DSC)**

Joseph H. Flynn *In its* Proc. of a Symp. on the Current Status of Thermal Analysis Oct. 1970 p 119–136 refs (See N71-32826 20-33)

Avail: SOD $1.00

Three instrumental time constants were found in an analysis of the differential scanning calorimeter: an energy pulse response, a temperature averaging network response, and a temperature programming response. The first constant may be determined from the decay of the response to infrared light pulses. It affects the shape of a transition curve but not the heat of transition calculated from the area. The second constant affects only the base line and the third, the temperature calibration. It was concluded that corrections for the various instrumental and thermal time constants are necessary if meaningful parameters are to be deduced, especially at fast heating rates. Author

**N71-32833#** National Bureau of Standards, Washington, D.C. Office of Flammable Fabrics.

**APPARATUS FOR RATE STUDIES OF VAPOR PRODUCING REACTIONS**

R. J. McCarter *In its* Proc. of a Symp. on the Current Status of Thermal Analysis Oct. 1970 p 137–150 refs (See N71-32826 20-33)

Avail: SOD $1.00

An apparatus was developed for measuring the rate at which

vapors are evolved during the thermal degradation of materials and thereby deriving the kinetics of such reactions. The apparatus yields a direct measure of reaction velocity, rather than the integrated indication obtained with thermogravimetric analysis. This simplifies the identification and calculation of kinetic parameters. Increases in sensitivity and operating range are also achieved. Flexibility in operation is obtained that permits the separate recording of reactions that tend to overlap. Author

**N71-32834#** Picatinny Arsenal, Dover, N.J. Solid State Branch.
**DIFFERENTIAL THERMAL ANALYSIS OF PRIMARY EXPLOSIVES: A MODIFIED TECHNIQUE**
R. J. Graybush, F. G. May (Defence Standards Lab., Melbourne, Australia), and A. C. Forsyth *In* NBS Proc. of a Symp. on the Current Status of Thermal Analysis Oct. 1970 p 151–164 refs (See N71-32826 20-33)
Avail: SOD $1.00

The usefulness of differential thermal analysis in the study of metastable materials has been hindered by the tendency of samples to explode during the experiment. A description is given of modifications which have been made to the remote cell so that the possibility of explosion is minimized. Using lead azide to evaluate the technique it is shown that complete curves for the exothermic decomposition: PbN6 yields Pb + 3N2 are reproducibly obtained. The endotherm in the curve corresponding to the fusion of the product lead serves as a confirmation of the reaction. Author

**N71-32835#** Enjay Labs., Linden, N.J.
**THERMOGRAVIMETRY OF VULCANIZATES**
John J. Maurer *In* NBS Proc. of a Symp. on the Current Status of Thermal Analysis Oct. 1970 p 165–185 refs (See N71-32826 20-33)
Avail: SOD $1.00

Thermogravimetric analysis provides an important advance in the analysis of elastomer compounds and vulcanizates. The current state of such investigations including a consideration of key experimental variables, precision and accuracy for estimating basic composition of different types of practical formulations is reviewed. Additional information is obtained by careful study of the oxidation characteristics of the carbon black in the formulation. The latter is influenced by both physical and chemical effects. Finally, an isothermal oxidation procedure is discussed for demonstrating differences in carbon black(s) and/or curatives in routine comparisons of samples. Author

**N71-32897*#** Rocketdyne, Canoga Park, Calif.
**EVALUATION OF ACOUSTIC CAVITIES FOR COMBUSTION STABILIZATION Final Report, 30 Jun. 1969–30 Jan. 1971**
C. L. Oberg, T. L. Wong, and W. M. Ford Jul. 1971 245 p refs
(Contract NAS9-9866)
(NASA-CR-115087; R-8757) Avail: NTIS CSCL 21B

The stabilizing influence of acoustic cavities on acoustic modes of combustion instability was investigated. Increased analytical capability was developed by removing or improving some of the previously used approximations and allowing for additional effects and configurations. Test firings were made to experimentally define an optimum slot width (slot width corresponding to maximum damping). Test firings were also made to investigate the effects of cavity location and of cavity multiplicity (multiple rows of resonators) on stability. Cavity temperatures were measured, unconventional cavity configurations (which emphasize hardware constraints) were studied, and stability with these cavities was tested. The effect of varying the film coolant flow rate and nominal operating conditions on cavity stabilization was investigated. The utility of these cavities was again demonstrated. Dynamic stability of the engine was obtained with a wide range of cavity configurations and conditions. Author

**N71-32932#** Watervliet Arsenal, N.Y.
**HEAT TRANSFER BY RADIATION AND CONVECTION FROM ANNULAR FINS OF TRAPEZOIDAL PROFILE ON A CYLINDER**
Garry C. Carofano and Manuel V. Avila Jan. 1971 91 p refs
(AD-723974; WVT-7102) Avail: NTIS CSCL 19/1

The equations describing steady heat transfer by radiation and convection from annular fins of trapezoidal profile on a cylinder are derived. Mutual irradiation between adjacent fins is considered and the appropriate differential angle factors are presented. A constant convection coefficient is assumed over all surfaces and the fins are treated as gray body radiators. The governing integral equations are approximated by numerical quadrature formulas and the resulting set of non-linear albebraic equations is programmed for solution. A Fortran program listing is included. Some results are obtained for the XM144E1 mortar tube. Author (GRA)

**N71-32949#** Purdue Univ., Lafayette, Ind. Thermophysical Properties Research Center.
**THERMOPHYSICAL PROPERTIES AT HIGH TEMPERATURES MEASURED BY DIRECT HEATING METHODS Technical Report, 1 Jul. 1969–31 Oct. 1970**
Raymond E. Taylor Wright-Patterson AFB, Ohio AFML Dec. 1970 69 p refs
(Contract F33615-70-C-1012)
(AD-724592; AFML-TR-70-286) Avail: NTIS CSCL 20/13

An analysis of direct heating methods, in which the sample is heated by passing an electric current through it, is presented. These methods are used for measuring thermophysical properties at high temperatures. It was demonstrated that mathematical approximations severly limit the applicability and accuracy of the techniques described in the literature. However, new techniques developed under the present program do not employ severe mathematical approximations and correctly include temperature-dependent properties. Thus the new techniques are significantly more accurate and orders of magnitude more flexible than the previous techniques. Data on the thermal conductivity, electrical resistivity, hemispherical total emittance, spectral normal emittance (0.65 microns) and Wiedemann-Franz-Lorenz ratio for two samples of Ta - 10W alloy to 2800 K are presented. Accuracies are believed to be within plus or minus 1% for the electrical resistivity, plus or minus 2% for the emittance and plus or minus 4% for thermal conductivity. Progress on the development of an apparatus to measure the thermal conductivity of carbon/graphite fiber is described. Author (GRA)

**N71-32973#** Rocketdyne, Canoga Park, Calif.
**THE EFFECT OF CHARGE TRANSPORT ON THE DISINTEGRATION OF LIQUID JETS Interim Report, 1 Jun. 1970–31 May 1971**
A. L. Huebner 27 May 1971 70 p refs
(Contract N00014-67-C-0474)
(AD-724334; R-8731) Avail: NTIS CSCL 21/3

Comparison was made between calculated values of the size of drops formed from electrified jets and experimental results in which apparatus was employed which progressively approached the model used in the theory. An initial procedure for extending the laboratory tests for measuring drop sizes from electrified jets to higher velocity jets was found to be unsatisfactory because of the large drop size encountered with unelectrified and slightly electrified simple jets. This led to development of an alternative procedure which will remove this problem. The role of ambient gas density and permittivity in the general theory of electrified jet breakup was developed. A critical review of charged drop literature was conducted, with major emphasis on instabilities, multiple disintegrations, heat transfer, and evaporative behavior. A model of charged-drop behavior in electric fields and subject to hydrodynamic and aerodynamic influences was developed. The relationship of this

model to design of experimental apparatus for the study of charged-drop behavior is delineated. Author (GRA)

**N71-32993#** Air Force Inst. of Tech., Wright-Patterson AFB, Ohio. School of Engineering.

**HOLOGRAPHIC INTERFEROMETER INVESTIGATION OF FREE CONVECTION FROM A NONUNIFORMLY HEATED VERTICAL PLATE**

Larry M. Baker (M.S. Thesis) Jun. 1971 73 p refs

(AD-724698; GA/ME/72-1) Avail: NTIS CSCL 20/13

Holographic interferograms were made of the laminar free-convection boundary-layer produced by a vertical flat plate with a non-uniform wall-temperature distribution. A transmissive-diverging diffuse-scene-beam technique was used. Photographs and relative positions of the features of the reconstructed scene were obtained using the primary real image, and using these photographs, boundary layer temperature profiles and average heat-transfer rates were predicted that agree with theoretically predicted values to within 10%. The focus position of the fringe pattern relative to the reconstructed plate appeared to coincide with the position relative to the actual plate of the centroid of the geometric shape defined by the wall-temperature and ambient temperature vrs. wall-position plot. Author (GRA)

**N71-33240#** National Aerospace Lab., Tokyo (Japan).

**SHOCK STAND OFF DISTANCE WITH MASS INJECTION**

Takashi Yoshinaga 1971 8 p refs In JAPANESE; ENGLISH summary

(NAL-TR-224) Avail: NTIS

It is shown that the reduction of radiative and convective heat transfer at the stagnation point due to blowing can be expressed explicitly in terms of the shock stand off distance ratio as a parameter. However, analytical correlation between the ratio and blowing rate has not been well established yet for the general blunted bodies except a spherical body. The present method provides general and relatively simple formulas for calculating shock stand off-distance of various blunt nose bodies. The results agree with experimental data for both spherical nose and flat nose bodies. Author

**N71-33304#** National Aerospace Lab., Tokyo (Japan).

**TWO DIMENSIONAL CASCADE TEST OF AN AIR COOLED TURBINE NOZZLE. PART 1: ON THE EXPERIMENTAL RESULTS OF A CONVECTION COOLED BLADE**

Toyoaki Yoshida, Kitao Takahara, Hiroyuki Nouse, Shigeo Inoue, Fujio Mimura et al 1971 31 p refs In JAPANESE; ENGLISH summary

(NAL-TR-231-Pt-1) Avail: NTIS

An experimental investigation was made of the aerodynamic and heat transfer performance of an air-cooled nozzle cascade for a high temperature turbine. The experimental equipment consisted of a low speed wind tunnel, a cooling air system, and a heater. For the representation of the heat transfer performance of the cooled blade, the relations between temperature difference ratio eta which expresses the cooling effectiveness of the blade surface temperature and several parameters such as main stream Reynolds number, incidence angle, weight flow ratio and temperature ratio are shown. Some possible corrections for the cooling effectiveness are discussed for the application of the data obtained from the cascade test to the turboengines. The value of eta at the leading edge is kept at a high level by an effective impingement cooling; on the other hand eta on the latter half of the blade toward the trailing edge region does not decrease extremely by virtue of rear injection. This indicates an improved cooling method for high temperature turbine nozzles. Author

**N71-33381#** Eidgenossische Technische-Hochschule, Zurich (Switzerland).

**ON QUANTUM MECHANICAL ENTROPY INEQUALITIES [UEBER QUANTENMECHANISCHE ENTROPIE UNGLEICHUNGEN]**

Fritz Baumann (Ph.D. Thesis) 1970 51 p refs In GERMAN

Avail: NTIS

Considered is the quantum mechanical entropy in the tensor product of three Hilbert spaces. A generalized matrix inequality is formulated by defining the slanted information of a value P in relation to a self-adjunct operator K as convex. Transl. by G.G.

**N71-33391*#** Mississippi State Univ., State College. Inst. of Environmental Sciences.

**MASS-ENERGY BALANCE FOR AN S-IC ROCKET EXHAUST CLOUD DURING STATIC FIRING**

Michael R. Smith and Richard E. Forbes 4 Aug. 1971 28 p refs

(Grant NGL-25-001-32)

(NASA-CR-61357; IES-70-10-1) Avail: NTIS CSCL 21B

A mass-energy balance was determined for the exhaust cloud generated during the static firing of the S-IC rocket engine (first stage of the Apollo 5 flight system). Measurements show that approximately 40,300 lb per second of cooling water are evaporated and entrained into the exhaust jet, which possesses a mass flux of 28,680 lb per second. The total energy of the exhaust products was 1.321 $\times$ 10 to the 10th power calories per second; however, after evaporating the cooling water only 0.5293 $\times$ 10 to the 10th power calories per second was available as sensible heat and kinetic energy. The total energy flux of the mixture was 1.765 $\times$ 10 to the 10th power calories per second. Thus, the available energy flux of the mixture as it was ejected into the atmosphere was about 40% of the total energy flux of the exhaust products and about 30% of the total energy flux of the mixture of the cooling water and the exhaust products. Author

**N71-33394*#** National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

**FILM BOILING FROM SPHERES: A COMPARISON OF THEORY AND DATA AT STANDARD AND REDUCED GRAVITY**

Robert C. Hendricks Washington Aug. 1971 13 p refs

(NASA-TM-X-2344; E-6325) Avail: NTIS CSCL 20M

Experimental film boiling heat transfer data for spheres emersed in liquid nitrogen are compared to analytic results. The analysis properly follows the data trends with sphere size, acceleration levels (approx 0.001 to 1 = a/g), and pressure (1, 3, and 5 atm); however, the predicted heat flux level is low. Author

**N71-33405#** Carleton Univ., Ottawa (Ontario).

**GASEOUS DETONATION. 1: TEMPERATURE MEASUREMENT OF DETONATION GASES**

Z. El-Ramly Jul. 1971 89 p refs

(ME/A-71-1) Avail: NTIS

The spectra of acetylene-oxygen detonation were studied in the wavelength range 3000 to 6000 A. Special interest was given to the continuums. It was found that the detonation products, in the case of stoichiometric and lean mixtures, radiate in black body manner, to a good approximation, in the wavelength range 5150 to 5650 A. This phenomenon was used to calculate the temperature of the detonation products. The temperature calculated using measured pressure and heat transfer, together with one dimensional detonation theory and the necessary thermodynamic data, is in the average about 250 K higher than the experimentally observed temperature. This difference is in the same direction as reported previously. It is also to be expected that the calculated temperatures

will be lower than those calculated here, if the flow field is calculated using the appropriate nonsteady calculations over the entire flow field beginning at the ignition point. Author

**N71-33448#** Office National d'Etudes et de Recherches Aerospatiales, Paris (France).
**SUPERFICIAL TEMPERATURES OF PROTECTIVE MATERIALS DURING COMBUSTION [TEMPERATURE SUPERFICIELLE DE MATERIAUX DE PROTECTION EN COMBUSTION]**
Jean Crabol 1971 4 p refs In FRENCH; ENGLISH summary Presented at the Colloq. de la Soc. Francaise de Phys., Evian, 25-29 May 1971
(TP-962) Avail: NTIS

In order to study the ablation mechanism of plastics reinforced by silica fibers under intense heating, an infrared micropyrometer has been designed for determination of the superficial temperatures. The measurements proved that these temperatures could reach 2500 K enabling the silica to melt and to show the action of combustion reactions by decomposition products. Author

**N71-33449#** Office National d'Etudes et de Recherches Aerospatiales, Paris (France).
**DIFFUSION AND COMBUSTION STUDY ON TWO PARALLEL SUPERSONIC FLOWS OF AIR METHANE [ETUDE DU MELANGE ET DE LA COMBUSTION DE DEUX FLUX SUPERSONIQUES PARALLELES D'AIR ET DE METHANE]**
Roland Borghi 1971 5 p refs In FRENCH; ENGLISH summary Presented at the Colloq. de la Soc. Francaise de Phys., Evian, 25-29 May 1971
(TP-961) Avail: NTIS

Experimental results concerning pressure measurements and gas samplings for an air-methane supersonic diffusion flame in a duct of constant area were compared with theoretical results from two dimensional calculations. The use of the Prandtl mixing length formula allowed for a satisfactory agreement; but the schematization of the combustion phenomena by a single chemical reaction did not succeed. Author

**N71-33572*#** Mathematical Applications Group, Inc., White Plains, N.Y.
**NONLINEAR COMBUSTION INSTABILITY: COMPUTER EXPERIMENTS USING CODES COMB AND TRDL**
Samuel Burstein and Harold Schechter Jul. 1969 253 p Prepared for JPL
(Contract NAS7-100; JPL-952505)
(NASA-CR-121472; MR-6906) Avail: NTIS CSCL 21B

Calculations using mathematical models resulted in two basic computer programs describing two dimensional time dependent hydrodynamic motion of a reacting system. A pancake model is used to compute the motion of a gas dynamic field in the transverse plane of an infinite cylinder while the second model, an annular model, describes the gas dynamic motion in an annular field bounded by a fuel injector plate and a subsonic-supersonic nozzle. Author

**N71-33617*#** National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
**RESPONSE OF CONVECTIVELY CONTROLLED BURNING TO NONLINEAR DISTURBANCES**
Marcus F. Heidmann [1971] 20 p refs Presented at the 3d Intern. Colloq. on Gasdyn. of Explosions and Reactive Systems, Marseille, France, 12-17 Sep. 1971; sponsored by AIAA
(NASA-TM-X-67892) Avail: NTIS CSCL 21B

A process where energy release rate is proportional to the square root of the Reynolds number of a burning particle or surface is used to demonstrate some distinctive dynamic properties of a disturbed convectively controlled burning process. The instantaneous energy release rates caused by assumed periodic flow field disturbances are numerically evaluated and examined. Correlation coefficients which express the energy released in-phase with the pressure disturbance are evaluated and analytical solutions for these coefficients are derived. The response of the process is shown to be highly sensitive to the harmonic distortion of the disturbance. For some disturbances the energy released in-phase with the pressure disturbance is an order of magnitude larger than that for linear (sinusoidal) disturbances. The results show that harmonic distortion increases the coupling between the burning process and the flow field. This amplifying effect of harmonic distortion is suppressed when a disturbance becomes steep-fronted; therefore, steepening can act to limit the equilibrium amplitudes in disturbed systems. Amplification is also suppressed when the velocity disturbance is phase shifted with respect to the pressure disturbance or when the process is exposed to a high steady velocity. Author

**N71-33644*#** Gulf General Atomic, San Diego, Calif.
**CONDITIONS FOR LOCAL THERMODYNAMIC EQUILIBRIUM IN URANIUM**
T. N. Delmer and W. G. Vulliet *In* Florida Univ. Res. on Uranium Plasmas and Their Technol. Appl. 1971 p 173-178 refs (See N71-33626 20-22)
Avail: SOD $3.75; NTIS CSCL 20M

Possible effects on uranium opacities due to populations of bound states not in local thermodynamic equilibrium (LTE) are investigated. The simple model used to calculate the pertinent atomic parameters is described. Although the model is capable of giving only qualitative results, it gives estimates of situations in which a uranium plasma will show deviations from thermodynamic equilibrium. Temperatures and densities at which these deviations become significant are given. Some cases in which non-LTE effects are important are discussed in detail, and the LTE values of the opacity and source function are compared with the correct values. Author

**N71-33656*#** Georgia Inst. of Tech., Atlanta.
**APPLICATION OF ZONING TECHNIQUES IN PRACTICAL RADIATIVE ENERGY TRANSPORT PROBLEMS**
Edward Y. H. Keng *In* Florida Univ. Res. on Uranium Plasmas and Their Technol. Appl. 1971 p 273-281 refs (See N71-33626 20-22)
(Grant NsG-273-62)
Avail: SOD $3.75; NTIS CSCL 20M

Methods which use zoning techniques to extend the existing results of a simple radiative energy transport model and thereby permit solutions to be obtained for many complex systems are discussed. View factors for black body and gray body systems and view factors among zones are presented. Nonisothermal emission conditions and approximation techniques for systems with variable extinction coefficients are outlined. J.M.

**N71-33682** Texas A&M Univ., College Station.
**ON THE ANALYTICAL SOLUTION OF THE NONLINEAR HEAT CONDUCTION EQUATION**
Antonio Campo (Ph.D. Thesis) 1970 82 p
Avail: Univ. Microfilms Order No. 70-16714

The nonlinear heat conduction equations including the influence of internal heat generation are studied. They are applicable to thermally isotropic and anisotropic media having thermal properties that depend on temperature. These equations can be converted to linear equations by means of algebraic transformations when the thermal properties of the media are power functions of temperature. The power functions describing the variation of thermal conductivity

with temperature for thirteen thermally isotropic materials and one typical thermally anisotropic material are tabulated. The algebraic transformations are employed to determine the temperature field and the heat transfer from radiating fins in thermally isotropic media and from two-dimensional convecting fins in thermally isotropic and anisotropic media. Dissert. Abstr.

**N71-33683** State Univ. of New York, Stony Brook.
**INFRARED RADIATIVE ENERGY TRANSFER IN NONGRAY GASES**
Surendra Nath Tiwari (Ph.D. Thesis) 1970 144 p
Avail: Univ. Microfilms Order No. 70-16009

Infrared radiative energy transfer in real gases is discussed. Several simple gaseous systems are analyzed. The first consists of a gas bounded by two parallel plates having the same temperature. Within the gas there is a uniform heat source per unit volume. For this system, both vibrational non-equilibrium effects and radiation-conduction interactions are investigated. The second system consists of fully developed laminar flow and heat transfer in a parallel plate duct under the boundary condition of a uniform surface heat flux. For this system, effects of gray surface emittance are investigated. With the single exception of a circular geometry, the third system considered is identical to the second system. Here the influence of nongray walls is also investigated, and a correlation between the parallel plates and circular tube results is presented. The particular gases selected for this investigation are, CO, CO2, H2O, CH4, N2O, and NH3. The temperature and pressure range considered are 300 - 2000 K, and 0.1 - 100 atmosphere respectively. Dissert. Abstr.

**N71-33684** Cornell Univ., New York.
**ON THE MIXED CONVECTION FROM A SPHERE AT SMALL REYNOLDS AND GRASHOF NUMBERS, PART 1. ON THE STABILITY OF VERTICAL NATURAL CONVECTION BOUNDARY LAYERS, PART 2**
Cornelius Adolph Hieber, Jr. (Ph.D. Thesis) 1970 122 p
Avail: Univ. Microfilms Order No. 70-17082

The perturbation effects of buoyancy upon the forced convection field arising from a heated isothermal sphere located in a vertical uniform stream (of magnitude U sub infinity) at small Reynolds numbers (R) are discussed. Applying the Boussinesq approximation and requiring that the buoyancy induced velocity be small relative to U sub infinity, it is shown that it is necessary that the Grashof number, G, be small with respect to R2 (both G and R being based upon the sphere radius, a). The stability of a laminar natural convection boundary layer arising from a semi-infinite vertical plate which is dissipating a uniform heat flux into the surrounding medium. The linearized disturbance vorticity and energy equations are integrated numerically via a fourth-order Runge - Kutta method. Dissert. Abstr.

**N71-33715*#** ITT Aerospace/Optical Div., Fort Wayne, Ind. Electro-Optical Operations.
**THE CONSTRUCTION AND TEST OF A DUAL PATCH MULTI-ELEMENT RADIANT COOLER Quarterly Report, 17 Sep. - 17 Dec. 1970**
R. V. Annable and J. F. Lodder Jan. 1971 54 p
(Contract NAS5-21132)
(NASA-CR-121476; QR-1) Avail: NTIS

The construction and test of a dual patch multi-element radiant cooler is reported. Studies showed that directional reflectivity effects at the inner cone surface are not critical to cooler performance, but that nonspecular effects are. Preliminary measurements showed that an effective cone wall emissivity can be achieved below the design value of 0.05. Cold traps and baffles were used to replace the anti-frost enclosures in the initial design. Author

**N71-33746*#** Kentucky Univ., Lexington. Boiling and Phase Change Lab.
**SOME NOTES ON THE DEVELOPMENT OF THE HYDRODYNAMIC THEORY OF BOILING**
Vijay Dhir Mar. 1970 34 p refs
(Grant NGR-18-001-035)
(NASA-CR-121467; PB-190591; TR-19-70-ME-6) Avail: NTIS CSCL 20M

Discussions are presented on dynamics and stability of small gravity and capillary waves and peak and minimum boiling heat fluxes. GRA

**N71-33752#** Ohio State Univ., Columbus.
**TRANSPORT PHENOMENA AT THE LIQUID VAPOR INTERFACE OF MERCURY USING A RADIOACTIVE TRACER**
Kyral Francis Wylie (Ph.D. Thesis) 1970 149 p refs
(Grants NSF GK-1148; NSF GK-10721)
Avail: NTIS

The advent of power stations employing nuclear fuel necessitated an evaluation of heat transfer agents, such as liquid metals, ordinary and heavy water. From studies of the characteristics of water, it is implied that inherent deficiencies exist for water as a heat transfer media. Included in this list are: (1) decomposition under the action of irradiation, rather large thermal neutron capture cross section, (2) corrosional agressiveness for most metals, and (3) reaction on contact with uranium. Furthermore, high pressures are required to achieve high water temperatures. On the other hand, owing to their thermal-physical properties, liquid metals as a heat-transfer agent are recommended. In general, good radiation stability and neutron-capture cross sections smaller than water are exhibited by liquid metals. The potential of higher heat transfer rates (for a given temperature difference) is offered by the high thermal conductivity of liquid metals. As a result of their lower vapor pressures (at a given temperature), compact-light weight high temperature heat transfer systems can be used. Author

**N71-33754#** Georgia Inst. of Tech., Atlanta.
**EQUATION OF STATE NEAR THE CRITICAL POINT**
Kenneth Chia Szu Kiang (Ph.D. Thesis) 1970 138 p refs
Avail: NTIS

An outline of thermodynamics near the critical point is presented including basic postulations, equations of state, thermodynamic equilibrium, statistical mechanics, and the first order phase transition in single component systems. Molecular force and phase transitions are discussed using van der Waals theory and the Ising model. The cluster theory and condensation are reviewed as well as the Mayer theory, the Frenkel and band droplet models, and Fisher's modified droplet model. Homogeneous equations of state for the liquid droplet model near the critical point are also discussed. J.M.

**N71-33769** California Univ., San Diego.
**COMBUSTION OF ALUMINUM PARTICLES IN O2/Ar**
Robert Piatt Wilson, Jr. (Ph.D. Thesis) 1970 276 p
Avail: Univ. Microfilms Order No. 70-15446

Isolated aluminum particles ignited by laser and burning in controlled mixtures of O2/Ar have been observed by cinephotomicrography in an effort to foster an accurate theoretical description of metal combustion. Designed to facilitate comparison with theory, the experimental technique employed photons to ignite and observe unusually small (20-100 micron) burning droplets. The burning rate law was matched to frame-by-frame measurements of droplet diameter by non-linear, least-square fit. A detached flame envelope exists and the diameter of this envelope is a constant multiple of the decreasing droplet diameter. Particles ignited by marginal energy flux suffer delayed ignition, accumulation of oxide on the droplet surface and often in the flame zone, and consequently these particles display irregular trajectories. Dissert. Abstr.

N71-33781 Texas A&M Univ., College Station.
**NUMERICAL SOLUTION FOR THE TRANSIENT TEMPERATURE FIELD AND THERMOELASTIC STRESSES OF A HOMOGENEOUS SPHERICAL FUEL ELEMENT WITH VARIABLE SURFACE HEAT TRANSFER**
David Edgar Beers (Ph.D. Thesis) 1970 200 p
Avail: Univ. Microfilms Order No. 70-16710

By introducing numerical techniques, the convective heat transfer coefficient can be based on empirical data which need not be defined mathematically. The transient heat conduction equation is derived using a spherical co-ordinate system. For the solution of the transient temperature equation on a digital computer using an explicit technique, an experimental analysis is given for determing the time increment necessary to achieve stability in the temperature distribution. Two methods are presented for the solution of the stress problem. The first method involves a stress function-displacement potential approach. An equation in terms of a defined displacement potential is derived which relates displacement and change in temperature. The second method involves inserting a constant of integration into the displacement potential equation derived in the first method and solving for this constant along with the displacement potential. Dissert. Abstr.

N71-33782 Arizona State Univ., Tempe.
**MEASUREMENT OF COMPLETE POOL BOILING HEAT TRANSFER CHARACTERISTICS FOR BINARY MIXTURES WITH EMPHASIS ON THE PARAMETRIC EFFECTS OF CONCENTRATION**
Stewart Richard Fischer (Ph.D. Thesis) 1970 322 p
Avail: Univ. Microfilms Order No. 70-16602

Heat transfer to boiling pure liquids and liquid mixtures was investigated using a transient technique to obtain data in all boiling regimes. Data was taken at atmospheric pressure for the following fluids boiling from a 2.38 cm diameter copper sphere: methanol, ethanol, isopropanol, n-butanol, acetone, carbon tetrachloride, Freon-113, water, isopropanol-water mixtures, n-butanol-acetone mixtures, ethanol-acetone mixtures and carbon tetrachloride-Freon-113 mixtures. The experimental data was compared to predicted results calculated from currently available correlation in order to determine the effect of mixture concentration on heat transfer in all boiling regimes. Since bubble growth and the associated liquid motion are important mechanisms in determining nucleate boiling heat transfer, mass diffusion, which retards bubble growth in mixtures, may significantly affect mixture nucleate boiling behavior. The Borishansky–Minchenko correlation and a correlation based on the Forster–Zuber parameters were found to satisfactorily correlate the pure component nucleate boiling heat transfer data. Dissert. Abstr.

N71-33784 Michigan State Univ., East Lansing.
**INVERSE PROBLEMS RELATED TO TRANSIENT CONVECTION IN THE THERMAL ENTRANCE REGION BETWEEN PARALLEL PLATES**
Raymond Strong Colladay (Ph.D. Thesis) 1969 118 p
Avail: Univ. Microfilms Order No. 70-15011

Transient heat transfer in the thermal entrance region between parallel plates with a fully developed laminar velocity profile is studied for low Peclet numbers flows. Axial heat conduction is included and its effect on the temperature profiles upstream of the heated region as well as in the entrance region itself is noted. The energy equation is solved numerically using an alternating direction implicit finite difference method. Two boundary condition cases are presented: (1) a uniform wall heat flux, and (2) a uniform wall temperature. The plate boundary upstream of the heated region is insulated in both cases. Steady state and transient results are presented for a range of Peclet numbers between 1 and 50. Using this solution as a basic building block in superposition, a number of inverse problems are formulated and presented in terms of integral equations. Particular emphasis is given to the inverse problem of estimating the mean velocity from temperature measurements at the wall and the solution of the energy equation. Dissert. Abstr.

N71-33785*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
**PRELIMINARY TEST RESULTS OF HEAT TRANSFER/THERMAL STORAGE TUBE DESIGN UNDER SIMULATED ORBITAL CONDITIONS**
David Namkoong Aug. 1971 52 p refs
(NASA-TM-X-67904) Avail: NTIS CSCL 20M

Heat-receiver tubes were tested as part of an investigation of a heat receiver for a solar Brayton-cycle power system. The tubes were designed to store excess solar energy during the orbital sunlit period and then to transfer the heat energy to the flowing gas during the orbital shade period. In this way constant thermal input to the Brayton system would be maintained over the entire orbit. The tubes utilized the heat of fusion of lithium fluoride as the heat-storage medium and were designed to accommodate the 23-percent volume change of LiF during phase changes. The columbium-1% zirconium tubes operated under a simulated oribital condition for 2002 hours and 1251 sun-shade cycles before going into a scheduled shutdown. Although there were no gross distortions of the convoluted LiF-storage tubes, local distortions were detected. During operation, the gas discharge temperature varied from 30 deg below nominal at the end of the shade period to 50 deg above at the end of sunlit period. Surface temperatures along the tube ranged from 1410 F to 1670 F. Author

N71-33791 Florida Univ., Gainesville.
**THERMAL EXPANSION IN CuK2Cl4-2H2O NEAR THE CURIE TEMPERATURE**
Joseph Wesley Philp (Ph.D. Thesis) 1969 87 p
Avail: Univ. Microfilms Order No. 70-14909

In the critical region data suggest a logarithmic singularity as found previously for the specific heat. Between 1.5 K and 2.5 K the thermal expansion coefficient is proportional to the inverse square of the temperature. Data suggest that the same inverse-square temperature dependence holds to measurements at 4.2 K. The linear thermal expension coefficient along the crystalline are given in terms of the temperature derivative of the isotropic two-ion spin correlation functions for first and second-nearest copper ions. The specific heat is described by the temperature derivative of the same two functions. For temperatures above 1.5 K where the specific heat and the expansion coefficient are proportional, both spin correlation functions have temperature derivatives proportional to 1/T sq. Results are consistent with the prediction that the specific heat and the linear thermal expansion coefficient are linearly related near the constant of proportionality between the asymptotic parts of these two functions gives the stress dependence of the transition temperature. Dissert. Abstr.

N71-33792# General Electric Co., Pleasanton, Calif. Nucleonics Lab.
**THERMODYNAMIC DATA PROGRAM INVOLVING PLUTONIA AND URANIA AT HIGH TEMPERATURES**
**Quarterly Report, 1 Aug. – 31 Oct. 1970**
E. A. Aitken and S. K. Evans Dec. 1970 7 p refs
(Contract AT(04-3)-189)
GEAP-12153; QR-13) Avail: NTIS

The continuing scope of work related to vaporization of uranía, oxygen activity at high temperatures, oxygen redistribution in a temperature gradient, and sodium fuel interactions was presented. Work progress is presented on these tasks. Author (NSA)

**N71-33842#** Technological Lab. RVO-TNO, Rijswijk (Netherlands).
**THE FUNCTION OF WEAK GUNPOWDER IN FIREARMS. THE THEORY OF INTERIOR BALLISTICS [DE FUNCTIONERING VAN ROOKZWAK BUSKRUIT IN VUURWAPENS. DE THEORIE DER INWENDIGE BALLISTIEK]**
J. G. Wissema 31 Dec. 1970 66 p refs In DUTCH
(TL-1970-21; TDCK-57936) Avail: NTIS

Considered is the safety and efficiency of weak gun powder in firearms as well as in rockets. The theory of interior ballistics is used to develop the pertinent formulas for computer evaluation of initial projectile velocity and pressure and temperature histories of the rifle barrels in relation to the used gunpowder and the weapon type. Transl. by G.G.

**N71-33862** Minnesota Univ., Minneapolis.
**HEAT TRANSFER IN THE SEPARATED REGION BEYOND A REARWARD-FACING STEP**
Win Aung (Ph.D. Thesis) 1969 197 p
Avail: Univ. Microfilms Order No. 70-15699

A study of heat transfer in the region of separated flow downstream of a rearward-facing step is conducted using the Mach–Zehnder interferometer. Step heights investigated are 0.38 cm, 0.64 cm, and 1.27 cm. The model walls are maintained at a uniform temperature. The external main flow of air is laminar and subsonic and the boundary layer at separation is thick. The velocity at the step is varied from 0.2 m/s to 14.3 m/s. Correspondingly the Reynolds number based on the distance at the step extends from 5.5 × 1,000 to 1.2 × 100,000. Results are presented for the regimes of pure laminar reattachment and transitional reattachment of the separated shear layer. In the laminar regime, the local heat transfer coefficient in the entire separated region is found to be less than the corresponding value for an attached laminar boundary layer. The redevelopment length necessary for the thermal boundary layer to approach that on a flat plate is about nine step heights beyond the point of reattachment. Dissert. Abstr.

**N71-33884** Columbia Univ., New York.
**THERMODYNAMIC STUDIES OF PALEOCLIMATES**
David Montgomery Shaw (Ph.D. Thesis) 1969 138 p
Avail: Univ. Microfilms Order No. 70-17045

A thermodynamic model of the general circulation of the atmosphere developed by Adem is applied to the problem of the causes of the ice ages. Adem's model accurately predicts the present equilibrium temperatures for the earth. The Ewing–Donn hypothesis of an ice-free Arctic Ocean is examined and found to be plausible and climatically stable. Surface temperatures in the summer near 9 C and in the winter near 2 C are calculated. Surrounding the ice-free Arctic Ocean by glaciated continents depresses temperatures in the summer to about 4 C and in the winter to about −1.6 C. It seems likely that the strong advection of cold air off the glaciated continents can refreeze the Arctic Ocean. Dissert. Abstr.

**N71-33918** Denver Univ., Colo.
**A THERMODYNAMIC STUDY OF THE COBALT-PLATINUM SYSTEM**
Robert VanArsdale Miner, Jr. (Ph.D. Thesis) 1969 77 p
Avail: Univ. Microfilms Order No. 70-16542

The activies of both components in cobalt-platinum solid-solutions show large negative deviations from ideal behavior. Accordingly, the alloys exhibit negative excess free energies of mixing which at 1100 C reach a minimum of about −2,360 for N sub Pt = 0.52. The negative values of delta G sup M,XS are primarily due to large positive excess entropies of mixing. It is shown that a magnetic contribution accounts for the major portion of the positive delta S sup M,XS. At 1100 C the magnetic contribution to delta S sup M,XS is estimated to be about 0.75 for N sub Pt = 0.5. This occurs on mixing at this temperature because the electrons responsible for ferromagnetism in cobalt can achieve a greater degree of spin disorder in the alloys since their Curie temperatures are lower than that of pure cobalt. Positive excess entropies of mixing characterized the alloys of the first-period ferromagnetic metals with the noble metals platinum, palladium, and gold, even at temperatures where any magnetic contribution should be small. Dissert. Abstr.

**N71-33951#** Kanner (Leo) Associates, Redwood City, Calif.
**HEAT OF FORMATION AND ENTROPY OF FORMATION OF PLUTONIUM CARBIDE**
V. V. Achacinskij Jan. 1971 13 p refs Transl. into ENGLISH from Proceedings of Panel Meeting on the Thermodyn. Properties of Uranium Carbides and Plutonium Carbides, Vienna, 9–13 Sep. 1968 Sponsored by AEC Prepared for LASL
(KFK-tr-71-22; Conf-680960-1) Avail: NTIS

The heats of formation for PuC0.87, Pu2C3, and PuC2 were calculated and compared with experimental data. The probable entropy values are also given. NSA

**N71-33956** Michigan State Univ., East Lansing.
**AN EVALUATION OF RELATIVISTIC THERMODYNAMICS**
Darryl Leonard Steinert (Ph.D. Thesis) 1969 67 p
Avail: Univ. Microfilms Order No. 70-15142

The problem of which of the formulations of relativistic thermodynamics that have been proposed by Planck, Eckart, Ott, and Landsberg as correct is examined. Due to the lack of experimental data on relativistic thermodynamic systems, it is not possible to compare predictions made by the various formulations with experimental data. But, using as a model the process of evaporation, it is possible to study the consistency between the transformation laws for temperature and for mechanical energy. The result obtained is that only the formulation by Ott is free of contradiction. Ott's proposed transformation laws are further evaluated in terms of their compatibility with relativistic formulations of fluid dynamics and statistical mechanics. The lack of contradiction between Ott's formulation and the transformation law for mechanical energy, and its compatibility with formulations of relativistic fluid dynamics and statistical mechanics, give support to a conclusion that the Ott formulation of relativistic thermodynamics is correct. Dissert. Abstr.

**N71-33972** Texas A&M Univ., College Station.
**LAMINAR FREE CONVECTION BETWEEN TWO HEATED VERTICAL PLATES**
Wen Ho Lee (Ph.D. Thesis) 1970 178 p
Avail: Univ. Microfilms Order No. 70-16742

The velocity and temperature distributions in a vertical heated channel, especially at the entrance region are examined. Two parallel plates, which form the walls of the channel, are kept at a temperature higher than or equal to the environment temperature. Laminar free convection is studied for Grashof number equal to 100 and 10,000, for Prandtl number equal to 0.733, and for ratio of plate height to width equal to 5. The non-linear partial differential equations governing the conservation of mass, momentum, and energy in this problem are solved by finite difference method. Some of the major findings include: Transient and steady state vorticity, stream function, and velocity distributions are obtained throughout the channel. Of particular interest are the conditions at the entrance of the channel. Dissert. Abstr.

**N71-33994** Washington State Univ., Pullman.
**THERMODYNAMIC INVESTIGATION OF THE EFFECT OF ELECTRON CONCENTRATION IN TERNARY ALLOYS BASED UPON THE ALUMINUM ZINC BINARY SYSTEM**

Ronald Eldon Miller (Ph.D. Thesis) 1970 92 p
Avail: Univ. Microfilms Order No. 70-16817

A reversible electrochemical cell was used to determine the thermodynamic activity of aluminum in a series of ternary alloys based upon the aluminum-zinc binary system. Silver was used as the primary ternary alloying element, although a few alloys contained a small amount of silicon. Temperature coefficients of the EMF's were determined, thereby allowing the calculation of enthalpies and entropies, as well as Gibbs free energies. The data are presented in the form of graphs which depict the excess relative partial molar Gibbs free energy of aluminum as a function of electron-to-atom ratio, and as a function of the mole fraction of aluminum. In addition, the origin of the positive values for the excess relative partial molar entropy of aluminum is discussed, with the conclusions that they probably result from an increase in the number of vibrational modes upon alloying. Dissert. Abstr.

**N71-33999#** Aeronautical Research Labs., Melbourne (Australia).
**THERMODYNAMIC REALATIONS IN THE CHROMIUM NITROGEN BINARY SYSTEM**
T. Mills Nov. 1970 28 p refs
(ARL/MET-84) Avail: NTIS

The pressure-temperature-composition relations of Cr2N have been studied in detail by a thermogravimetric technique. The free energies, enthalpies and entropies of the reactions of nitrogen with chromium have been calculated from partial free energy data, taking into account the variation in the composition limits of the Cr2N phase with temperature and its wide homogeneity range. Author

# 34 GENERAL

Includes information of a broad nature related in industrial applications and technology, and to basic research; defense aspects; information retrieval; management; law and related legal matters; and legislative hearings and documents.

**N71-32820#** Koln Univ. (West Germany). Inst. fuer Geophysik und Meteorologie.
**THE REQUIREMENTS OF AN OPEN COMPUTER CENTER FROM THE INDIVIDUAL USER'S POINT OF VIEW [UEBER DIE ANFORDERUNGEN AN EIN OFFENES RECHENZENTRUM VON SEITEN DES EINZELNEN BENUTZERS]**
H. Zschoerner Oct. 1970 48 p refs In GERMAN *Its* Mitt. No. 13
Avail: NTIS

The general systematics of scientific work using computers as a tool are discussed. The discussion is based on the use of an "open" computer center, its usefulness as a toll for scientific research, its influence on scientific research and practical work, and the role of the user in the total configuration. ESRO

**N71-32886#** National Oceanic and Atmospheric Administration, Rockville, Md. BOMEX Project Office.
**BOMEX BULLETIN, NO. 4**
1 May 1969 107 p refs Sponsored by AEC, DOC, DOD, NASA, NSF, Dept. of Interior, and DOT
Avail: NTIS CSCL 05B

Project BOMEX is designed to explore one of the key processes governing the physical behavior of atmosphere and oceans. The energy received by the planet earth from the sun in the form of short wave radiation is stored as heat primarily in the upper layers of the tropical oceans. In contrast, the earth loses heat rather uniformly at all latitudes by infrared radiation. The resulting net gain of heat in tropical latitudes and net loss in polar latitudes is compensated by an energy flux from low to high latitudes which is accomplished by the atmosphere rather than the oceans. Therefore, the heat stored in the oceans has to be transferred to the atmosphere. This energy exchange may be visualized in three steps. In the first step energy from the upper ocean layers transfers by "sea-air interaction" to an atmospheric boundary layer of 5,000 to 6,000 feet depth, the so called tradewind layer. In the second step, this energy finds its way into deeper layers of the troposphere by convective action. The third step transports the redistributed energy from tropical to higher latitudes. Author

**N71-32887#** Army Electronics Command, Fort Huachuca, Ariz. Atmospheric Sciences Lab.
**A COMPUTER METHOD FOR RETRIEVING INFORMATION ON ARTICLES, REPORTS, AND PRESENTATIONS**
Ernest B. Stenmark Sep. 1970 44 p refs
(AD-724611; ECOM-6050) Avail: NTIS CSCL 5/2

A FORTRAN language computer program was written to permit selective information retrieval from listings of reports, articles, and presentations maintained as a computer card master file and on magnetic tape as a working file. The program features a simple, routine method for updating both files, and completely flexible, automatic extraction of specific listings according to such criteria as type, origin, date, date of entry to the file, and subject category. Author (GRA)

**N71-33301*#** Environmental Science Services Administration, Rockville, Md. BOMAP Office.
**BOMEX BULLETIN, NO. 5**
Nov. 1969 27 p refs Sponsored by AEC, DOC, DOD, NASA, NSF, Dept. of Interior, and DOT
(NASA-CR-121421) Avail: NTIS CSCL 05B

An outline of the transitor from BOMEX to the new BOMAP (Barbados Oceanographic and Meteorological Analysis Project) is presented. The BOMEX Project Office has been disestablished and a new office, BOMAP, has been established within the ESSA Research Laboratories. This office will coordinate data handling and data exchange and will conduct the analysis of the primary sea-air interaction (Core Experiment). The field phases of BOMEX, which has been successfully concluded is reviewed. The objectives and structure of BOMAP, and the plans for scientific analysis of the BOMEX data are outlined. The management of the BOMEX data are reviewed with specific information of how, when, and where to get data. The coordination of data processing and results with BOMEX investigators and the scientific community are discussed. Author

**N71-33328*#** Standord Research Inst., Menlo Park, Calif.
**THE STUDY OF COST ESTIMATIONS AND ECONOMIC ANALYSES OF ROCKET MOTORS AND ROCKET MOTOR SYSTEMS (COST ESTIMATION FOR SOUNDING ROCKET DESIGNS) Final Report**
Patrick J. Martin [1970] 29 p
(Contract NAS7-773)
(NASA-CR-111951; SRI-Proj-MU-8283) Avail: NTIS CSCL 05C

The feasibility of compression-molded plastic motor cases and nozzles for solid rockets is demonstrated. This demonstration consisted of hydrostatic tests, design calculations, and static tests of short-length motors. Ten alternative sounding rocket motor designs of comparable ballistic performance and the engineering cost estimates of each. The designs based on the comparison-molded inert parts will cost less to manufacture than the present meteorological RDT and E rocket motor and its metal-case conceptual alternatives. Recommendations are made to more fully develop the advantages of the palstic case rocket and to overcome the disadvantages. Author

**N71-33417#** RAND Corp., Santa Monica, Calif.
**TECHNOLOGY ASSESSMENT: A BIBLIOGRAPHY**
Ethel L. Chamberlain Jan. 1971 11 p refs
(P-4541) Avail: NTIS

A selected bibliography is presented dealing with changes in technology on existing technologies, social systems and the environment in general, with special emphasis on developing mechanisms to access these effects. Included are references to industry studies as well as theoretical discussions and some studies of the future. Author

**N71-33436#** SAIT Electronics S.A., Brussels (Belgium).
**COMPUTERIZED SYSTEM FOR INFORMATION RETRIEVAL [SYSTEME D'AUTOMATISATION DU PROCESSUS DE LA RECHERCHE DOCUMENTAIRE]**
Emile Peeters (Centre de Rech. Sci. et Tech. de l'Ind. des Fabr. Metal.) and Maurice Wirtz Centre de Rech. Sci. et Tech. de l'Ind. des Fabr. Metal. May 1971 28 p In FRENCH Sponsored by IRSIA
(CRIF-EL-2) Avail: NTIS

The Belgian SESAM computerized information system applied to automatic control is described. ESRO

**N71-33474#** Joint Publications Research Service, Washington, D.C.
**CONFERENCE DEVOTED TO AN INTERNATIONAL ORBITAL LABORATORY AND SPACE SCIENCE AND THE TWENTIETH CONGRESS OF THE INTERNATIONAL ASTRONAUTICAL FEDERATION**
Ye. A. Ilin *In its* Space Biol. and Med., Vol. 5, No. 3, 1971 12 Aug. 1971 p 141 – 146 refs (See N71-33451 20-04)
Avail: NTIS

Briefly reviewed are reports presented at a conference that summarize problems concerning the creation and use of orbital stations with emphasis on the bioastronautical aspects involved. Topics range from cabin atmosphere control methods to weightlessness effects and possible reasons and consequences of emergencies in space. G.G.

**N71-33592*#** National Aeronautics and Space Administration, Washington, D.C.
**SAFETY AND MAINTENANCE ENGINEERING: A COMPILATION**
1970 22 p
(NASA-SP-5928(01)) Avail: NTIS CSCL 13L

This compilation includes diverse items, united by a subject of universal interest: safety. Spanning a broad range of applications, from high power illumination to high rise construction, the items represent some of the safety oriented innovations developed by NASA and AEC. The concept of safety, taken in its broadest interpretation, includes hazard identification and elimination (accident prevention), as well as mitigation of the effects of accidents, for apparatus and personnel. Thus, the subjects of the items presented range from the obviously safety related, such as life preservers and safety restraints, to those which may be classed as preventive maintenance. The compilation has been roughly sorted into four sections: (1) general personnel safety; (2) electrical safety; (3) general equipment safety; and (4) fire safety. Author

**N71-33693*#** Virginia Univ., Charlottesville. Dept. of Environmental Sciences.
**ENVIRONMENTAL APPLICATION OF REMOTE SENSING METHODS TO COASTAL ZONE LAND USE AND MARINE RESOURCE MANAGEMENT. THE POTENTIAL OF REMOTE SENSING AS A DATA BASE FOR STATE AGENCIES: THE VIRGINIA MODEL**
H. G. Goodell and W. Reed Mar. 1971 134 p Prepared for Geol. Survey, Washington, D.C.
(NASA Order W-13165; Contract USGS-14-08-001-12540)
(NASA-CR-119721; USGS-210) Avail: NTIS CSCL 05D

A study of the structure of the governmental hierarchy of Virginia as it is organized to carry out its responsibilities is reported. The investigation includes the data used in the function of each agency, the method of its collection and dissemination, and the rationale for its use in decision-making. It also includes the potential impact of remote sensing as an alternative or supplemental data base in the function of these agencies and an evaluation of required imagery and resolution and sensory frequency. Author

**N71-33716#** National Science Foundation, Washington, D.C. Analytical Studies Group.
**SCIENCE RESOURCES STUDIES: HIGHLIGHTS**
25 Jan. 1971 4 p refs
(NSF-70-49) Avail: NTIS

A brief analysis is presented of Federal funding of academic science for fiscal year 1969. Funding for research and development, manpower development, facilities and equipment, general support for science, and other science activities are covered as well as funding by Agency. Institutional patterns of support are also discussed. J.M.

**N71-33720#** National Bureau of Standards, Washington, D.C.
**INTERNATIONAL TRADE: US METRIC STUDY Interim Report**
Gerald F. Gordon Jul. 1971 182 p
(NBS-SP-345-8) Avail: SOD $1.50

An evaluation was made of the potential effects that a U.S. conversion to the metric system may have on the Nation's foreign trade. The report is based on a survey of exporters and importers trading in measurement sensitive products, which was conducted by the Bureau of Domestic Commerce of the Department of Commerce. Author

**N71-33758#** Committee on Appropriations (U.S. House).
**CIVIL SUPERSONIC AIRCRAFT DEVELOPMENT (SST)**
Washington GPO 1971 116 p Hearings before a Subcomm. of the Comm. on Appropriations at the 92d Congr., 1st Sess.
Avail: US Capitol, House Document Room

Comments on continuing fiscal year 1971 transportation appropriations for SST and Concorde development are presented. Environmental issues, productivity, technological leadership, and economic viability are discussed as well as international travel and the percentage of program completion. J.M.

**N71-33800#** Committee on Aeronautical and Space Sciences (U.S. Senate).
**CONGRESSIONAL RECOGNITION OF GODDARD ROCKET AND SPACE MUSEUM WITH TRIBUTES TO DR. ROBERT H. GODDARD**
Washington GPO 1970 108 p
(DOC.-91-71) Avail: US Capitol, Senate Document Room

Statements made during the Hearing on Senate Concurrent Resolution 49 were documented in a compilation of materials relating to Congressional recognition to the Goddard Rocket and Space Museum, Roswell, New Mexico. Certain tributes to Dr. Robert H. Goddard were documented and a short biography was included. J.G.M.

**N71-33801#** Committee on Science and Astronautics (U.S. House).
**NASA AUTHORIZATION, 1972, PARTS 1 – 4 Index**
Washington GPO 1971 418 p Index for Hearings on H.R.3981 before Comm. on Sci. and Astronautics, 92d Congr., 1st Sess.
Avail: US Capitol, House Document Room

Hearings before the Committee on Science and Astronautics, U.S. House of Representatives, during the Ninety-Second Congress are indexed. J.G.M.

**N71-33825#** George Washington Univ. Washington, D.C.
**CONVERSION OF SCIENTIFIC AND TECHNICAL RESOURCES ECONOMIC CHALLENGE: SOCIAL OPPORTUNITY**
Ellis R. Mottur Mar. 1971 205 p refs Sponsored by NBS and US Arms Control and Disarmament Agency
(GWPS-Mon-8) Avail: NTIS

Conversion of America's scientific and technical resources from defense to civilian objectives is an urgent national necessity. While the need for conversion presents the nation with a significant economic challenge, it also affords an unparalleled social opportunity of turning our technical talents toward the resolution of America's besetting social ills in areas such as pollution, transportation, housing, urban services, health care, and education. The economic challenge and social opportunity presented by conversion are described and a series of policy proposals set forth as a national program for conversion of scientific and technical resources. Author

**N71-33870*#** Wisconsin Univ., Madison. Space Science and Engineering Center.
**[TIME DOMAIN DATA EXTRACTION, RADIO, ALTIMETRY, AND APPLICATION OF ATS DATA] Quarterly Report, 1 Apr. – 30 Jun. 1971**
V. E. Suomi 30 Jun. 1971 8 p ref
(Contract NAS5-11542)
(NASA-CR-121438) Avail: NTIS CSCL 05B

Progress in the following areas was reported: time domain data extraction, radio altimetry, and applications of ATS data. An operational prototype system for measuring wind field data sets from cloud motion in ATS pictures was developed. Research on the radio altimeter progressed toward completion of a final model for experimentation and flight testing. A study relating satellite measurements of cloud brightness to rainfall rate and stream discharge was reported. J.G.M.

**N71-33872#** Committee on Appropriations (U.S. Senate).
**DEPARTMENT OF HOUSING AND URBAN DEVELOPMENT, SPACE, SCIENCE, VETERANS, AND CERTAIN OTHER INDEPENDENT AGENCIES APPROPRIATIONS FOR FISCAL YEAR 1972**
Washington GPO 1971 1010 p Hearings before a Subcomm. of the Comm. on Appropriations on R.9382, 92d Congr., 1st Sess.
Avail: US Capitol, Senate Document Room

The Senate hearings on appropriations are presented for the Federal Home Loan Bank Board, Renegotiation Board, Selective Service System, National Science Foundation, Commission on Population Growth and the American Future, Office of Science and Technology, Securities and Exchange Commission, National Aeronautics and Space Council, Department of Housing and Urban Development, National Aeronautics and Space Administration, Federal Communications Commission, and Veterans Administration N.E.N.

**N71-33909#** Committee on Appropriations (U.S. House).
**HUD-SPACE-SCIENCE APPROPRIATIONS FOR 1972, PART 1**
Washington GPO 1971 1444 p Hearings before a Subcomm. of the Comm. on Appropriations at the 92d Congr., 1st Sess.
Avail: US Capitol, House Document Room

The subcommittee hearings concerning requests for HUD and space appropriations are reported. Organizations appearing included: Commission on Population Growth and the American Future, Federal Home Loan Bank Board, National Aeronautics and Space Administration, National Aeronautics and Space Council, Office of Science and Technology, Renegotiation Board, and Veterans' Administration. F.O.S.

**N71-33948#** National Research Council of Canada, Ottawa (Ontario).
**PUBLICATIONS OF THE DIVISION OF MECHANICAL ENGINEERING AND THE NATIONAL AERONAUTICAL ESTABLISHMENT, SERIES NO. 2, SUPPLEMENT 4**
Jan. 1971 20 p refs
Avail: NTIS

An annotated bibliography is presented of aeronautical, mechanical engineering, and test reports published in January 1971. Feature articles from quarterly bulletins and miscellaneous papers are also listed. J.M.

**N71-33957#** Radio and Space Research Station, Slough (England).
**CATALOGUE OF REPORTS AND REPRINTS IN WORLD DATA CENTRE C ROCKETS AND SATELLITES**
1971 9 p refs *Its* Issue No. 1
Avail: NTIS

A list is presented of rocket and satellite reports and reprints on hand at World Data Center C. General areas covered are: space research; satellites and probes; orbits and flight paths; applications of satellites; magnetic fields; radiation; and ionospheric radio wave propagation. A.L.

**N71-33961#** Committee on Science and Astronautics (U.S. House).
**NASA AUTHORIZATION, 1972 Index for Hearings, Parts 1 – 4**
Washington GPO 1971 415 p Hearings on H.R. 3981 (superseded by H.R. 7109) before Comm. on Sci. and Astronaut., 92d Congr., 1st Sess.
Avail: Comm. on Sci. and Astronaut.

An index for hearings before the 1972 Committee on Science and Astronautics of the U.S. House of Representatives is presented. The catalog lists the proposed contributing witnesses in alphabetical order together with the requested information sought from each individual. G.G.

**N71-33975#** Istituto Superiore di Sanita, Rome (Italy). Lab. di Fisica.
**SOME ABSTRACTING AND INDEXING PERIODICALS IN THE FIELD OF PHYSICAL SCIENCES [ALCUNE BIBLIOGRAFIE PERIODICHE NEL CAMPO DELLE SCIENZE FISICHE]**
V. Alberani 27 Jul. 1970 45 p refs In ITALIAN; ENGLISH summary
(ISS-70/21) Avail: NTIS

The growing significance of abstracts, indexes, and literature reviews as a means of communicating scientific information is discussed. Some abstracting and indexing periodicals in the field of physical sciences are listed, and the main features of each are summarized. Author

ENVIRONMENTAL APPLICATION OF REMOTE SENSING METHODS TO COASTAL ZONE LAND USE AND MARINE RESOURCE MANAGEMENT. THE POTENTIAL OF REMOTE

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# NEW NASA PUBLICATIONS

### Analysis of Apollo 10 Photography and Visual Observations (NASA SP-232)

In addition to describing the mission of Apollo 10—the necessary predecessor of the Apollo 11 landing on the Moon—this book contains miniature halftones of the photographs taken by Astronauts Stafford, Cernan, and Young, and tells how scientists may obtain the photographs for further study. Index maps of the photography are included. *Paperbound.* 240 pp. For sale by the Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402, for $4.25.

### Apollo 14: Preliminary Science Report (NASA SP-272)

This publication contains the early scientific results from the third manned lunar landing, carried out at Fra Mauro by astronauts Shepard and Mitchell. The results reported in this volume are the product of work performed by the assigned scientific investigators in the months immediately following the mission. *Paperbound.* 324 pp. For sale by the Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402, for $3.00.

### Spacecraft Charge Buildup Analysis (NASA SP-276)

By WILLIAM S. WEST, ET AL

A publication from Goddard Space Flight Center that presents estimates of the electrical potential for various spacecraft environments for a typical deep-space trajectory. The information is relevant for planning use of small nuclear power systems during missions beyond 2.5 or 3 astronomical units. *Paperbound.* 48 pp. For sale by the National Technical Information Service, Springfield, Va. 22151, for $3.00.

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